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VIEWS OF THE SOUTH CLIFF OF CLIFTY CREEK, MILFORD, INDIANA.

(a) View of the south end of the cliff. (b) View of the center of the cliff.

(See page 100.)

INDIANA.

DEPARTMENT

OF

Geology and
Natural Resources.

TWENTY-FOURTH ANNUAL REPORT.

W. S. BLATCHLEY,

STATE GEOLOGIST.

1899

INDIANAPOLIS:

W. M. B. BURFORD, CONTRACTOR FOR STATE PRINTING AND BINDING.

1900.

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STATE OF INDIANA,
EXECUTIVE DEPARTMENT,
INDIANAPOLIS, January 25, 1900. }

Received by the Governor, examined and referred to the Auditor of State for verification of the financial statement.

OFFICE OF AUDITOR OF STATE,
INDIANAPOLIS, January 25, 1900. }

The within report, so far as the same relates to moneys drawn from the State Treasury, has been examined and found correct.

W. H. HART,
Auditor of State.

79621

January 26, 1900.

Returned by the Auditor of State, with above certificate, and transmitted to Secretary of State for publication, upon the order of the Board of Commissioners of Public Printing and Binding.

CHAS. E. WILSON,
Private Secretary.

Filed in the office of the Secretary of State of the State of Indiana, January 25, 1900.

UNION B. HUNT,
Secretary of State.

Received the within report and delivered to the printer this 8th day of February, 1900.

THOS. J. CARTER,
Clerk Printing Bureau.

State of Indiana, Department of Geology and Natural Resources.

INDIANAPOLIS, IND., January 25, 1900.

HON. JAMES A. MOUNT, *Governor of Indiana:*

DEAR SIR—In accordance with law, I submit to you herewith the manuscript of the Twenty-fourth Annual Report of the Department of Geology and Natural Resources. It comprises the reports of the chiefs of the different divisions of the Department for the calendar year 1899, together with papers relating to the economic geology and natural history of the State.

Yours very truly,
W. S. BLATCHLEY,
State Geologist.

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ISADORE KESSLER, Indianapolis, Ind.....Stenographer.

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DEPARTMENT OF GEOLOGY AND NATURAL RESOURCES.
INDIANAPOLIS, IND.

W. S. BLATCHLEY, State Geologist.

PLEASE ACKNOWLEDGE RECEIPT OF THIS VOLUME.

**In return, Scientific Books, Fossils, etc., and Implements of the "Stone Age"
are acceptable.**

State Museum, Room 126, Third Floor, State House.

Office of State Geologist, Room 89, Third Floor, State House.

INTRODUCTORY.

It was the original intention to make a paper on the cement resources of Indiana the leading feature of the present report. Several circumstances, chief among which were the illness of the writer and the immense amount of work entailed upon the chief assistant in the editing and proof-reading of the last report, preventing the gathering of complete data for the cement paper. Its publication has, therefore, been deferred for one year.

The present volume deals more with the natural history than with the geology of Indiana. When this Department was reorganized, in 1881, the first phrase of the act was as follows: "A Department of Geology and Natural History is hereby established." In 1889, for political reasons solely, the name was changed to that which it now bears—"Department of Geology and Natural Resources."

Up to 1895, there had appeared in the reports of the Department papers relating to the fishes, batrachians, reptiles and butterflies of the State, together with papers on the flora of isolated counties or groups of counties. In the reports issued by the writer since 1895, papers on the crayfishes, cave fauna and birds of the State have been published. Believing that there is a demand, especially in the common schools, for a more accurate knowledge of the other forms of life now existing in the State, arrangements were some time ago made with specialists for the preparation of papers on the shells, plants and certain groups of insects occurring in the State. On account of the large amount of information pertaining to coal, it was found impossible to publish any natural history paper in the Twenty-third Report, and the present volume, therefore, contains three of the more important of those whose preparation had been authorized.

These are:

First—"The Dragonflies of Indiana," by E. B. Williamson, of Bluffton. Mr. Williamson was, for several years, under the special instruction of the late Professor Kellicott, of Columbus, Ohio, a noted specialist in this particular group of insects. He has, since his graduation, continued his work on the group, and has made large collections in different parts of Indiana. In the present paper he has given a full description of each species found in the State, together with notes pertaining to its life history, habits, etc. There are also

keys by which the student will be able to readily determine any species which he may have in hand. The young of dragonflies furnish much food for fishes, and in turn they, as well as the adults, prey upon the larvæ and mature forms of many insects, especially mosquitoes, so that the paper has an economic as well as a purely scientific phase.

Second—"A *Descriptive Catalogue of the Mollusca of Indiana*," by R. E. Call. Dr. Call was for several years the Superintendent of Schools at Lawrenceburgh, and while there arrangements were made with him for the preparation of this paper. He is a noted specialist on mollusca and has published many important articles and catalogues relating to shells. Some of these, pertaining to Indiana shells, have appeared in the Proceedings of the Indiana Academy of Science. In the present paper every shell, both land and fresh water, known to occur in the State, is described, and almost all of them are figured. This paper, it is believed, is the most complete and valuable ever published by any state on its molluscan fauna.

Third—"A *Catalogue of the Flowering Plants and of the Ferns and Their Allies Indigenous to Indiana*," by Stanley Coulter. This paper represents a collection of data covering a period of over six years and the results of a study of the flora of the State for over twenty years. In it an attempt is made to show the significance of plant life. It therefore discusses plants as interpreting soil, moisture and temperature conditions, with lists of plants typical of our various soils added by way of emphasizing the conclusions reached. It also considers in some detail certain economic relations, such as forests and reforestation, weeds and their extermination, poisonous plants and their recognition, plants in their relation to bird life; emphasizing, as far as is possible, the intimate relations existing between these lower life forms and the practical affairs of life. It is the hope that in the form presented it may prove suggestive to the teacher and helpful to the agriculturist and horticulturist. The forms included are, with few exceptions, represented in the herbaria of the State, and their listing under the nomenclature of Britton and Brown's Flora will prove of service to botanists.

In addition to the three articles on natural history above mentioned, there are two short papers on the Geology of Southeastern Indiana, by Messrs. Foerste and Price, and a paper on the Natural Resources of the State, by myself. The annual reports of the State Supervisor of Natural Gas, Inspector of Mines, and Supervisor of Oil Inspection are also included in the volume.

THE NATURAL RESOURCES OF THE STATE OF INDIANA.

BY W. S. BLATCHLEY.

The main province of the Department of Geology is, in the writer's opinion, the advertising of the natural resources of Indiana. This advertising is accomplished in two ways. First: By annual reports, of which the present volume is the twenty-fourth in the series and the fifth issued under the auspices of the writer. Second: By the Department serving as a bureau of information or a medium between the owners or lessees of the lands on which the natural resources are located and the prospective user or producer of such resources. For example, a certain person or company desires information as to where he or they can find glass sand, fire-clay or undeveloped coal lands within the State. A letter is addressed to the Department, making inquiry concerning the resource desired. An answer is at once written giving full information as to where such deposits are located, name of owner and such other information as is at hand. This information is wholly gratis, no fees whatever being charged either party. In this way hundreds of letters are annually answered and much capital directed to sources of investment which it is believed will prove remunerative. On the other hand many people are warned against investing money in trying to develop certain resources which do not occur in a locality where they are thought to be.

To give a general idea of the main resources of the State and their location the present paper has been prepared. While it contains, in part, information which was published in the Twentieth and Twenty-first Annual Reports, it gives in addition much which has been gathered since their publication.

Ranking in area of square miles but thirty-fourth among the forty-five states of the Union, Indiana, on January 1, 1899, stood sixth in the production of coal, fourth in the production of petroleum, second in the production of natural gas, seventh in the production of build-

ing stone and sixth in the value of her clay products. According to careful computations, the value of each of the five leading mineral resources produced in Indiana in 1898 was as follows:

Petroleum	\$2,228,276
Coal	5,177,044
Natural gas	5,060,969
Stone	1,731,914
Clay products	3,211,512
Total	\$17,409,715

The capitalist seeking profitable investment, whether it be of a commercial or manufacturing nature, must ever take into consideration a number of elements upon the presence or absence of which the success of his enterprise will largely depend. The first and greatest of these is the law of supply and demand. If he is dealing in or producing an article for which a demand exists or can be readily created—equal to or in excess of the supply—his success is well-nigh assured. If, on the other hand, he buys or begins the manufacture of an article which is already largely in stock, or for which the demand has begun to decrease, his future is apt to be a stormy one. He should, therefore, previous to making his investment, give long and careful study to all the conditions relative to the future supply and demand of the article in which he proposes to deal or which he intends to make. If his investment is for manufacturing or productive purposes—as most likely it will be—the elements, in addition to the one of supply and demand, which should be noted are:

1. Transportation facilities.
2. Fuel supply.
3. Quantity and quality of raw material.

Lying, as she does, between the Great Lakes on the north and the rugged or mountainous regions of Kentucky and Tennessee on the south, the State of Indiana furnishes a comparatively level plain, 240 miles in length and 145 miles in width, across which must pass all the main arteries of travel between the east and the west. No less than nineteen great through trunk lines of railway, carrying the passengers and freight of a mighty nation, cross all or a portion of her width, while seven important north and south systems run the full length of the State. Adding to these the numerous branches running diagonally and connecting the main lines, we have a most complex system of railways, whose branches permeate almost every nook and corner of our commonwealth. Moreover, electric railways, which in

the future will furnish cheap and rapid means of transportation, are fast being constructed throughout the State. From the main lines of steam or electric railways, switches can be readily and cheaply constructed to the site of any resource lying within the State which promises to yield a fair amount of freight for the future. When to these facilities we add those of the waterways of Lake Michigan on the north and the Ohio on the south, we have avenues of transportation unexcelled by any State in the Union.

In the following pages it will be shown that the other two elements—*fuel* and *raw material*—so necessary to a great manufacturing community, are abundant in Indiana.

FUELS.

The natural fuels of Indiana are three in number, viz., petroleum, natural gas and coal. These fuels are the most valuable resources of our State to-day. They are all stored products which have been formed in ages past, and no one of them is now being produced beneath the surface of our State. Taking them up in the order named, we find that their locations and statistics of production are as follows:

PETROLEUM.

Crude petroleum occurs in Indiana in commercial quantities in two distinct geological formations. The principal one of these is the

Trenton limestone, which underlies the whole State, *Petroleum in* but which, up to the present, has produced oil in paying quantities only in an area of about 500 square miles. *Trenton*
Limestone.

This area is divided into a main portion, or main field, and several minor areas. The main field is located in the counties of Adams, Jay, Blackford, Wells, Grant and Huntington. This field extends from the Ohio State line to Marion, Grant County, and averages about twelve miles in width. Full details concerning the topography of this area, together with a map and account of the oil industry therein, were published in the report of this Department for 1896.

Outside of this main field, isolated pools or small areas of Trenton rock productive of oil are found at Peru, Miami County, and near Keller's Station, Wabash County; Alexandria, Madison County, and Broad Ripple, Marion County.

The oil in the Trenton rock is a dark, ill-smelling liquid, with a specific gravity of .853, or 35° Beaume. It is found only in the uppermost sixty feet of the Trenton, and is usually in two porous strata or

"pay streaks," which are separated by a non-porous stratum 15 to 25 feet in thickness. Over the larger part of the State these porous strata are wholly lacking in the Trenton rock, and hence no gas or oil is found when the drill pierces that formation.

The cost of operating a lease in any of the Indiana Trenton rock fields is as low or lower than elsewhere in the eastern United States for the following reasons: (a) The wells are comparatively shallow, the Trenton limestone in most instances being struck at less than 1,000 feet. (b) It is seldom that more than 150 feet of drive pipe and 400 feet of casing are necessary. (c) On account of a comparatively level surface a large number of wells can be connected to and pumped with one power. (d) Gas for fuel or for running gas engines is usually plentiful. (e) Transportation facilities are excellent, a system of pipe lines permeating all parts of the main field.

The second rock formation productive of oil in Indiana is the Corniferous, the lowermost division of the Devonian system found in the State. This formation occurs only in the western *Petroleum in* half of Indiana, where it is represented either by sand-*the Corniferous* stones 10 to 20 feet in thickness or by limestones *Formation* 5 to 65 feet thick—sometimes by both. Oil has been found in the Corniferous limestone at Terre Haute, Vigo County; Petersburg, Pike County, and near Medaryville, Jasper County, and in a corresponding sandstone at Loogootee, Martin County. This oil has probably, in all the above mentioned localities, been derived from the overlying black or brown Genesee shale, which is from 95 to 160 feet in thickness, and very rich in bitumens.* These bitumens have, by natural processes, often been separated from the shale, and in the form of gas or petroleum have been collected in porous reservoirs either in the shale itself or in the underlying Corniferous limestone or sandstone. The shale or original source of the oil or gas is much thinner than the Trenton limestone, and hence the amount of oil or gas formed from the distillation of organic bodies therein must have been correspondingly less. Moreover, the shale lies nearer the surface, and a greater loss of the volatile products of distillation must have taken place. For these two reasons the supply of gas or oil in the Corniferous will never equal that found in the Trenton limestone, and the life of any field or area in which it is discovered will be relatively shorter. The oil of the Corniferous is darker colored, more ill smelling and of a greater density and weight than that found in the Trenton limestone.

* A paper treating of the bitumens of this shale was published in the report of this Department for 1896, pp. 108-119.

The year 1899 was not characterized by any great strikes or new developments of importance in the oil fields of Indiana. During the first half of the year the rapid rise of price in iron pipe and most other supplies used in oil production deterred many prospective wildcatters and even old operators from putting down new bores. The price of Indiana crude oil remained almost stationary (74 to 76 cents) until June, when it began slowly to creep upward. By July it had reached 82 cents, and by September 1, 90 cents. On the 15th of September it had advanced to 99 cents, and soon thereafter climbed above the dollar mark. On January 1, 1900, it was selling at \$1.12 per barrel.

This advance in price in the latter half of the year caused a corresponding increase in activity among the operators. Wildcatters, too, began to be more restive, and cast a longing eye on territory which promised a chance, however remote, for a return of their money. As a result, a number of bores were put down in various localities a few miles outside the limits of the main field as shown in the map in the

1896 report; while in a number of places territory which, from the data available, was then shown as "light oil territory," and which had been considered comparatively valueless, was proven by new bores to be highly productive. Good examples of such bores are on section 32, Chester Township, Wells County, and in a number of sections in Jackson Township of the same county. In fact, this latter township developed in 1899 more new wells which proved excellent producers than any other similar area in the main field.

It was predicted in my report of 1896 that the Indiana oil field is connected with that of Ohio, and that the line of connection would be found to be in northeastern Jay, or southeastern Adams County, perhaps both. The results of the drilling in 1899 in part fulfilled this prediction. In September a well was drilled in on the Dudgeon farm in section 27, Blue Creek Township, Adams County, and only 300 feet west of the State line, which had an initial production of 75 barrels. In November another good well was drilled in on the Hoblet farm in the same section. Two small producing wells were also located two miles west in section 29, and two or three just east across the Ohio line. On December 20, the field contained seven wells with a total daily production of about 90 barrels. The southernmost well in this field is several miles north of all former bores put down to find the connecting link between the two States.

On January 10, a well which started at 250 barrels was drilled in on the Storms lease in section 19, Washington Township, Blackford County, thus extending the known field three miles to the southwest.

A number of other good producing wells were afterward located in the same and adjoining sections, so that the main field now extends to the western limit of Blackford County.

Other fair producing wells just outside the main field, as mapped in 1896, were located during the year in sections 10 and 16, Center Township, Grant County, and a good one was finished, in December, in section 19, Salamonie Township, Huntington County.

A wildcat bore which produced a good showing of oil and much salt water was put down near Lafontaine, Liberty Township, Wabash County. Another well, which filled up with 300 feet of oil, and would produce 15 barrels daily, was finished in wildcat territory near Hagers-town, Wayne County, 50 miles south of the heart of the main field and 40 miles southeast of Alexandria. The nearest producing wells are at Parker, Randolph County.

Progression in the Peru field was wholly backward during the year. But three productive wells were drilled in and these had a total initial production of only 40 barrels, or an average
The Peru of 13 barrels each. Four dry holes were put down
Oil Field during the year, and 37 wells, formerly productive,
in 1899. were abandoned. The total production of the field was 250,297 barrels, as against 446,672 in 1898. The first productive bore south of the Wabash River was drilled in on the Snyder farm in August. Its output was, however, small, and one or two dry holes in its vicinity stopped further drilling in that direction.

At Keller's Station or Rich Valley, Noble Township, Wabash County, fifteen bores were put down during the year. Of these six were dry, while nine had a total initial output of but 55 barrels daily. In Erie Township, Miami County, just west of the Rich Valley field, the results were much better. Here, also, 15 wells were drilled in, of which but four were dry. The producing ones had an average initial production of 24 barrels.

The area of the Broad Ripple field was not materially increased during 1899. But 11 wells were completed. Of these, 10 were productive and one dry. The total initial product was
The Broad 265 barrels, or an average of 26.5 barrels per well. The
Ripple Field total production was 51,000 barrels, as against 102,087
in 1899. in 1898, a loss of just 50 per cent.

On account of the anti-gas waste law, no oil was produced in the Alexandria field during 1899. An appeal from the decision of the Indiana Supreme Court was taken by the oil operators and was argued before the United States Supreme Court the latter part of December. The chances are that, as soon as the gas supply fails, not only the

Alexandria field but a large part of the other territory now producing gas will yield oil in quantity.

Two small oil fields were developed during the year 1899 at quite a distance from the main field. The oil in both was found in the Corniferous limestone or a correlative sandstone, this being the same stone in which oil was discovered at Terre Haute in 1889. The original source of the oil in each—as at Terre Haute—is undoubtedly the New Albany or Genesee shale.

One of the new fields was near Loogootee, on the B. & O. S. W. Ry., in Martin County. Five bores were put down by a local company. The first was drilled just south of the town to a depth of 1,682 feet and produced only a slight showing of oil. A second and third well were sunk—each a quarter of a mile farther eastward than the preceding—but only to a depth of about 530 feet, when gas was struck. In October these wells showed a rock pressure of 200 pounds per square inch and yielded about 400,000 cubic feet of gas each per day.

The fourth well was put down about 90 rods east of the third and at that point showed the sand stratum to be 16 feet in thickness. This well yielded both gas and oil—the latter flowing at the rate of about 20 barrels daily. The oil is dark in color and has a specific gravity of 32° Beaume. A fifth well, only 700 feet east of the fourth, was a dry hole. This was the sum total of the developments to January 1, 1900. Loogootee is 532 feet above sea level and the depth to Trenton rock is about 1,900 feet.

The other prospective field was in Gillam Township, Jasper County, about six miles west of Medaryville. Oil in small quantity was found in eight wells at a depth of only 105 to 110 feet below the surface. Little or no gas was found, the oil-bearing limestone being so near to the surface that all volatile portions had escaped. The oil is very dark and heavy, the specific gravity being but about 24° Beaume, and is sold mainly for lubricating purposes. On January 1, 1900, the total yield from the eight wells was about 40 barrels daily.

Eleven thousand barrels of oil were produced from the Phoenix well in the city of Terre Haute during the year 1899. This well was drilled in on the night of May 6, 1889, and for more than ten years has yielded an average of 1,000 barrels or more per month. The oil is found in the Corniferous limestone which underlies the black Genesee shale, at a depth of 1,630 feet from the surface.

When the drill first struck this oil-bearing stratum, on the date above mentioned, the flow was so great that quite a lake of oil ac-

accumulated around the derrick, and there was some alarm lest a destructive fire should result. The drills were then pulled out of the well, and as soon as the end of the drill left the mouth of the drive pipe, a solid stream of oil four and a half inches in diameter shot into the air a distance of forty or fifty feet. While running at this rate there was probably a little over a barrel a minute pouring from the well, and when the pressure decreased from the first spurt, which lasted only fifteen minutes, the flow steadied down to a four and a half inch stream spurting about three feet above the mouth of the well. A tank with a capacity of twenty barrels was put under the pipe, and it was filled to overflowing in just twenty-two minutes.

This great flow soon began to decrease, and in a few months had reached an average of 35 barrels per day, which it has since maintained. However, it is by far, the best oil well ever drilled in Indiana, since no other has kept up so high a production for more than five years.

The result of this strike was like that of every other similar one in the history of the petroleum industry. Hundreds of oil operators from far and near flocked to Terre Haute. Real estate almost doubled in price. Twenty-four new companies were formed, eighteen of which made locations. A dozen or more bores were put down to the required depth within three miles radius of the first gusher, struck the proper stratum, and for the most part found—nothing. Two, within a short distance of the original well, yielded oil in small quantity. The yield of one was soon overcome by salt water. The other continued to produce for five or six years, but was finally abandoned.

No further prospecting was done until 1899, when two bores were completed. One of these, about two miles north and one-half mile west of the Phoenix, was a dry hole. In the other, about 40 rods north-east of the Phoenix, oil was found, which partially filled the bore. The well was probably good for ten barrels per day, but litigation was begun against the owners, and up to January 1, 1900, it was not producing.

Previous to the sinking of the Phoenix well, three or four bores had been put down, one to a depth of 2,400 feet. In two of these oil in small quantity had been found.

There is little doubt but that a large quantity of oil underlies the city of Terre Haute and vicinity, else the yield of the Phoenix well could not have been so long continued. The porous area or reservoir containing it must, however, be narrow, and this bore probably struck it at just the right point to get the best results. As noted on a previous page, there is little chance of ever developing an oil output from

the Corniferous limestone, in any way comparing to that from the Trenton rock, on account of the much greater area and thickness of the latter formation.

The total production of petroleum in Indiana in the year 1899 was 3,818,713 barrels,* which, at the average price of 87½ cents per barrel, amounted to \$3,341,374. Compared with 1898, this was an increase in production of 67,406 barrels, or 1.7 per cent. Owing, however, to the much higher average price, the amount received was \$1,113,098, or, approximately, 50 per cent. more than in 1898, and \$341,374 more than in any year since oil was discovered in the State. The greatest production, heretofore, was 4,680,732 barrels, in 1896. This, at 63 cents—the average price for that year—amounted to \$2,954,411.

The following is a complete record of the monthly production of petroleum in the Indiana fields, beginning in January, 1891, and closing with December, 1899:

* This includes 11,000 barrels produced at Terre Haute but does not include the amount used for fuel and other purposes in the field.

TOTAL PRODUCTION OF PETROLEUM IN INDIANA FROM 1881 TO 1899 BY MONTHS.

[Barrels.]

MONTH.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
January.....	6,171	15,841	111,824	259,000	300,568	365,582	290,746	317,014	298,207
February.....	5,981	18,946	96,025	232,107	230,559	241,743	309,922	272,780	221,256
March.....	5,150	24,734	134,549	292,376	310,303	386,586	341,981	825,301	291,173
April.....	4,973	26,184	146,483	297,330	352,077	385,052	328,779	310,034	326,690
May.....	5,757	31,033	186,989	321,502	397,001	417,963	340,023	311,208	345,755
June.....	8,136	40,998	209,616	333,479	403,569	434,167	369,803	320,477	335,198
July.....	10,809	49,203	221,666	327,349	434,376	422,968	375,249	314,861	330,002
August.....	11,403	56,109	248,353	346,031	409,132	407,238	371,921	332,777	349,537
September.....	16,500	66,034	245,615	319,588	409,169	415,675	362,528	326,254	333,199
October.....	19,029	95,699	252,568	339,424	393,153	384,233	406,179	319,490	327,697
November.....	20,801	129,270	245,607	304,030	373,780	337,231	430,958	200,644	327,718
December.....	21,715	144,057	236,038	337,450	361,436	362,164	423,069	300,457	353,162
Total.....	136,634	698,068	2,335,293	3,689,666	4,396,132	4,680,732	4,353,138	3,751,307	3,818,713

PRODUCTION OF PETROLEUM IN INDIANA FROM 1889 TO 1899.

	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
Total production (barrels of 42 gallons).....	33,375	63,496	136,634	698,068	2,335,293	3,689,666	4,396,132	4,680,732	4,353,138	3,751,307	3,818,713
Total value at wells of all oils produced, excluding pipeage.....	\$10,881	\$32,462	\$54,787	\$230,620	\$1,050,382	\$1,774,290	\$2,807,124	\$2,954,411	\$1,871,819	\$2,228,276	\$3,341,574
Value per barrel.....	\$0 324	\$0 511	\$0 40	\$0 37	\$0 45	\$0 48	\$0 64	\$0 63	\$0 43	\$0 594	\$0 874

In the following table there is shown the number of wells put down in Indiana for petroleum in each month since June, 1891:

NUMBER OF WELLS COMPLETED IN THE INDIANA OIL FIELDS FROM 1891 TO 1899, BY MONTHS.

YEAR.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891.....							6	6	15	15	15	8	65
1892.....	11	13	18	13	17	19	17	31	25	52	33	47	295
1893.....	20	30	31	36	45	47	47	55	27	72	56	76	542
1894.....	90	103	103	80	110	107	84	123	100	107	97	85	1,189
1895.....	61	45	81	111	122	153	132	140	129	106	102	85	1,267
1896.....	76	90	86	136	148	150	113	121	70	58	66	66	1,180
1897.....	41	35	40	47	49	52	60	45	55	89	119	54	686
1898.....	41	23	29	43	38	55	53	80	72	82	92	86	694
1899.....	75	48	68	64	87	99	77	104	106	120	106	106	1,060
Total.....													6,978

From the above table we learn that there was greater activity in oil operations in Indiana in 1899 than in any year since 1896. On January 1, 1900, there were 4,336 wells producing oil in the State, as against 3,628 on January 1, 1899—a gain of 708 for the year. The table also shows that 6,978 wells have been sunk within the State for petroleum, so that 2,642 of those completed have either proven dry or were abandoned previous to January 1, 1900. The number abandoned in 1899 was 247; while the number of dry holes drilled during the year was 105. This was but a fraction less than 10 per cent. of the total bores put down.

Comparing the following table with the one above, we learn that this was the smallest percentage of dry holes put down in any year since oil was discovered in the State.

TOTAL NUMBER OF DRY HOLES DRILLED IN INDIANA OIL FIELDS FROM 1891 TO 1899, BY MONTHS.

YEAR.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1891.....							0	2	5	4	3	1	15
1892.....	2	6	6	2	3	4	2	3	3	18	6	21	76
1893.....	7	10	10	6	14	6	11	9	5	14	10	9	111
1894.....	19	14	24	14	13	13	9	21	15	14	8	17	181
1895.....	7	4	13	16	22	20	15	23	12	12	9	13	166
1896.....	10	13	6	28	26	20	14	19	4	4	6	8	158
1897.....	8	9	7	12	5	16	11	9	16	11	18	8	130
1898.....	14	4	2	13	9	6	7	10	12	8	13	16	114
1899.....	5	9	14	5	5	7	12	9	12	14	8	5	105

Taking into consideration the large number of bores put down, the small number of dry holes resulting, and the high average price received for the oil produced, the year 1899 was one of the best in the history of the Indiana petroleum industry. The prospects for 1900 are, at the present writing, very bright. While new territory of importance may not be opened up, the high price of the liquid, if maintained, will stimulate the sinking of many new bores in territory already productive. The average yield per well may not be so great, for the days of the gusher are probably ended. But it should be remembered that one large well will not make any man a fortune; twenty small ones may in time. The yield of the large one will quickly grow much less; that of the twenty small ones will hold out for a long time. There is yet room for thousands of wells in the territory known to contain oil. At present prices, ten wells pumped by one power, and yielding on an average but three barrels each per day, will prove a paying investment.

NATURAL GAS.

Natural gas, the cleanest and best natural fuel known to man, occurs in greater or less quantity in an area approximating 2,800 square miles in the eastern-central part of the State. It is found in the uppermost 50 feet of the Trenton limestone—a great rock formation which underlies the entire State, with an average thickness of about 500 feet. This limestone does not outcrop within the State, and its closest known proximity to the surface is near Lawrenceburgh, Dearborn County, where it is 348 feet below.

It is only in such parts of this limestone as have, by natural agencies in the remote past, become porous that the gas is stored. It

was generated or formed thousands of years ago by the destructive distillation of the animals or plants buried in this limestone, and in time found its way into the uppermost porous strata, which have served as a storehouse or reservoir for its keeping. When the overlying Utica shale, a very dense and close cover which the gas can not pass through, is pierced by the drill the gas escapes or passes upward into the iron pipes which carry it wherever needed. Whenever the drill passes through the Utica shale and strikes the Trenton limestone where it is not porous, no gas or oil is found. Over the greater portion of the State the limestone is non-porous, and hence both oil and gas are lacking. The oil, as well as the gas, was formed from the animal and plant life buried in the Trenton limestone, the gas being only the lighter or more volatile product, which has arisen into the highest stratum of the porous reservoir, or into the apex of the arch or anticlinal in which the stored products are found.

It is now almost universally admitted that the rock pressure in any oil or gas field is nothing more nor less than water pressure, as in artesian wells, the water entering the porous stratum at some point where the latter outcrops and so forming a head or source. Hence, the deeper the well the greater the head of water and the higher the rock pressure. The porous rock contains a limited amount of gas, held in place by the overlying shale. The salt water is below this gas, ever pressing it upward into the vent furnished by the drill hole. As the supply of gas is gradually exhausted, the water rises to fill the pores, and the rock pressure is lowered. The pressure does not tell us anything about the volume or amount of gas stored in the rock; but the rate of diminution of pressure furnishes an excellent index of the rapidity with which that amount is being lessened. The salt water usually overcomes the gas pressure and drowns out or shuts off a well long before the rock pressure has been reduced to zero. In the Indiana field the average pressure in 1890 was 325 pounds. On the first of January, 1900, it was 155 pounds. The average well is drowned out, i. e., the supply of gas is shut off, at about 130 pounds. From this it will be seen that the future of natural gas in the State is not a promising one.

The highest use to which natural gas can be put is that of household consumption. With no kindling, no replenishing, no ashes, no soot, the duties of the housewife are decreased many fold. On account of the near failure of the supply, all new factories which are thinking of using gaseous fuel should be warned against locating in the Indiana gas field, instead of being attracted thither by promises of free gas. The coal bearing counties of Indiana will furnish cheap and plenteous

fuel for many years to come, and to those counties we would recommend all capitalists seeking sites for factories, when fuel is the principal factor to be considered in the choosing of the site.

In view of the rapid failure of the supply of natural gas, many manufacturers are turning their attention to "producer gas," or gas made by forcing air into an incandescent mass of coal or coke. The coal from many veins in western Indiana is shown by analysis to be well suited for the making of producer gas, and one of the largest rolling mills in the city of Terre Haute has been using such gas made from Vigo county coal for ten years. This company claim that they can make a ton of iron with the gas produced from 800 pounds of coal. Dr. W. A. Noyes, of the Rose Polytechnic Institute, who has made many coal analyses for this Department, has written as follows concerning this subject: "The heating power and the value for making producer gas of the Indiana coals is practically identical with that of the Pittsburgh coals, so far as the combustible matter which they contain is concerned. The Indiana coals differ from the eastern bituminous coals chiefly in that they contain more moisture and more sulphur. These reduce their heating power and their value for making producer gas as compared with the Pittsburgh coals, *but only by five to ten per cent. on the average.* The heating value and the gas producing value of coals from either region will be very nearly in proportion to the per cent. of combustible matter, that is, to the sum of the 'volatile combustible matter' and 'fixed carbon' which they contain."*

There is little doubt, therefore, but that, on the failure of the supply of natural gas for manufacturing purposes, the factories now in the gas belt will be able to use petroleum, or producer or other gas made from Indiana coal, where the coal itself can not be directly used, on account of the nature of the wares produced. Indeed, it will be the housewife, and not the factory owner, who will suffer the most inconvenience when the supply of the gaseous fuel shall have completely failed.

For full details concerning the condition of the Indiana gas field at the close of the year 1899, the reader is referred to the report of the State Supervisor of Natural Gas, in another part of the present volume.

In the following table will be found a statement of the value of the natural gas produced in Indiana from 1886 to 1898, inclusive:

* For tables of complete analyses of Indiana coals see pp. 105 and 106 of the 21st (1896) Annual Report of this Department; also pp. 1569 and 1570 of the 23d (1898) Report.

VALUE OF NATURAL GAS PRODUCED IN INDIANA FROM 1886 TO 1898.

Year.	Value.	Year.	Value.
1886	\$300,000	1893	\$5,718,000
1887	600,000	1894	5,437,000
1888	1,320,000	1895	5,203,200
1889	2,075,702	1896	5,043,835
1890	2,302,500	1897	5,009,208
1891	3,942,500	1898	5,060,969
1892	4,716,000	Total	\$46,723,714

COAL.

During the year 1899 there was a great increase of activity in the coal regions of Indiana. The output from the mines was far greater than in any previous year. Many hundreds of acres of the best coal deposits changed hands, having been secured by parties having large capital to invest. Much of this land will be held for future development, but in a number of places extensive mines are being established, and the coal output bids fair to be doubled within the next three years.

This increased activity in the coal industry was due to several reasons. Chief among these was the great wave of prosperity which our country, as a whole, experienced, and which has caused such an activity in manufacturing interests as to greatly enhance the demand for fuel. A second reason was the growing of the belief, now general, that the life of natural gas in Indiana, for both manufacturing and household purposes, is a very short one, and that when such fuel fails the value of the coal lands will increase to a great extent. A third reason was that, for the first time in recent years, accurate data relative to and maps showing the exact location of all coal deposits in the State became available on the issuing of the Twenty-third Report of this Department.

This volume, containing 1741 pages and seven large maps, is devoted wholly to the coal interests of the State. It shows that the coal deposits of Indiana cover about 7,500 square miles, of which between 6,000 and 7,000 square miles are underlain by coal. They are confined exclusively to the southwestern part of the State, and lie west of a line passing through Williamsport, Greencastle, Paoli and a little to the east of Cannelton. There are between 20 and 30 horizons at which coal occurs, of which five contain workable coal over large areas, and not less than seven others contain workable coal over

small areas. The workable coal runs from 3 feet to 10 feet in thickness. The upper beds or "bituminous" coals average between 4 and 5 feet thick, while the lower or "block or semi-block" beds average 3 feet 1 inch. The upper beds occur in large basins, often hundreds of square miles in area, through which they often maintain great uniformity of thickness and minor detail. The lower beds are characteristically in small basins, often of only a few acres, but some with an area of several square miles. The coal in these basins is thick in the center and thins toward the edges.

The Indiana coal field is part of the eastern edge of the Illinois coal field, so that all the coal and other rocky beds tend to dip or get deeper toward a point in southern Illinois. The result of this is that along the eastern edge of the Indiana field only the lowest coal bed is found. Going westward this descends at the rate of about 24 feet to the mile, and gradually the other beds set in, until, along the Wabash River, the lowest bed may be 700 or 800 feet below the surface, and as high as 16 other beds have been found above it in a single drilling, the total thickness of the coals in this case being over 32 feet. As a rule not more than one or two workable beds will be found at any locality, and at many points, constituting together perhaps one-fourth of the field, none of the underlying beds are workable. In a few cases three or more beds are workable at a single point.

The eastern edge of the field, including eastern Fountain and Parke, Putnam, Owen, eastern four-fifths of Greene, Martin, Dubois, Orange, Crawford, Spencer and Perry, contains but limited quantities of workable coal. Most of this area is hilly. The lower, pocketed coals are nearing outcrop, so that most of the mines are small and worked by drifting. These coals tend to be block or semi-block.

West of this belt is another from 10 to 20 miles broad where the coals are still shallow, the mines seldom reaching a depth of 100 feet. The coals are block or semi-block, and, though in pockets, are largely workable. This belt is flat or rolling. It crosses western Fountain, central Parke and Clay, western Greene, central Daviess, eastern Pike and Warrick counties.

Still west of this is a third belt 10 to 20 miles wide, where the upper coals are near outcrop and extensively mined. The coals in belt two are here deeper, and, as a rule, not workable. Most of the mines of the State are in this and the preceding belt. This third belt covers Vermillion, southwestern Parke, Vigo and western Clay, eastern Sullivan and Knox, western Daviess, Pike and Warrick counties.

Gibson, Vanderburgh and Posey and western Sullivan and Knox counties comprise a fourth belt or area, where the upper coals are

generally workable but deep; the mines, as a rule, being 250 feet or more in depth. The lower coals are here usually thin. On account of the surface rocks in this area showing little or no coal, the impression is general that there is but little coal in this belt. The data at hand lead to the conclusion, however, that not only is this view erroneous, but that this area will some day prove the richest part of the Indiana field.

The most active mining regions at present are in Clay and Vigo, southern Parke and Vermillion, and eastern Sullivan and western Greene counties. The quantity of coal in Clay and Greene is not great, but will yet last for many years. Parke and Vermillion counties have somewhat larger quantities. The coal of Vigo and Sullivan counties, though long and extensively mined, has hardly as yet been touched. This is still more true of Knox, Gibson and Vanderburgh counties. Pike county has a bed of unusual thickness outcropping or very near the surface, but as yet hardly touched. The same bed is present in Warrick County, though not covering as large an area. Daviess County still has much workable coal but in thin beds. Limited areas of unmined block coal exist in southeastern Parke and western Clay counties and near Patricksburg, Owen County.

This block coal is the most valuable coal in the State. It is as pure as splint coal, is almost free from sulphur or phosphorus, and has the softness and combustibility of wood. In burning, it swells so little that its expansion is scarcely perceptible, does not change form, and never cakes or runs together; hence, it is a most valuable fuel for the blast furnace and the cupola of the iron founder.

For steam and household purposes it has an unrivaled reputation. It burns under boilers with a uniform blaze that spreads evenly over the exposed surface, thus securing a more uniform expansion of the boiler plates. Its lack of sulphur also causes it to have but little detrimental effect upon the boiler, grates or fireboxes. In household grates it burns with a bright, cheerful blaze, like hickory wood, making a very hot fire, which, for comfort and economy, can not be surpassed by any fuel except an abundant supply of natural gas.

All told, there is estimated to be 40 billions of tons of coal in Indiana, of which one-fifth, or 8 billions, are estimated to be workable under present conditions. It is estimated that 100 million tons, 1-400 of the total amount, or 1-80 of the workable amount, have been mined out. Assuming that the past rate of increase of production be maintained, it is estimated that the field will last not less than 300 years.

The use of coke for domestic fuel is largely on the increase in south-

ern Indiana and Illinois. It is gradually taking the place of anthracite coal, as the price of the latter advances year by year.

Coke From Indiana Coal. Coke weighs but about 40 pounds per bushel, so that the bulk of a ton is twice as great as that of anthracite, whereas the heating power per bushel is two-thirds as great. Coke is, at present, made in Indiana only at

Ayrshire, Pike County, where David Ingle has 24 ovens in operation. These are the old-fashioned "bee-hive" ovens, in which all the gases, ammonia and other by-products set free from the coal during the process of coking are allowed to escape. It is estimated that each ton of Indiana coal contains 25 pounds of sulphate of ammonia and 60 to 70 pounds of tar, besides one-third or more of its weight in volatile combustible matter. In the "bee-hive" oven these are wholly lost. In weight the amount of coke realized is about 49 per cent. that of the coal used. In other words it takes two tons of coal to produce one ton of coke. The latter, however, is of excellent quality and the demand for it is constantly increasing. It brings about \$2.10 per ton at the ovens, and retails for domestic use at St. Louis and elsewhere at \$5.00. The freight rate to St. Louis is 75 to 80 cents per ton.

The coals from veins V, VI and VII (1898 Report), are well suited for coking, and much of the pea and slack coal hitherto wasted or sold for a low price could, when washed, be used to advantage for coke making. Especially would this be true if improved ovens, utilizing or saving all by-products, were erected.

The report of the State Mine Inspector, Mr. James Epperson, shows that 5,865,123 tons of coal were mined in Indiana in 1899. This was an increase of 688,079 tons over the output of 1898, which was the largest in the history of the State.

This increase was due to the absence of the usual strikes on the part of the miners in the leading coal districts in the State, and to a largely increased demand for Indiana coal during the last three months of the year. This demand was in part brought about by the shortness of the supply of natural gas and a consequent storage of coal for winter use. There is no doubt but that the demand for Indiana coal will gradually increase as the supply of gas grows less, and the chances are that the output will reach 10,000,000 tons per annum before the year 1910.

According to the report of Mr. Epperson, the following is the relative rank of the fifteen coal producing counties for the year 1898, together with the output of each, the total number of miners employed in mines working ten or more men, and the amount of wages paid:

		Tons.	Number of Men.	Amount of Wages Paid.
1	Clay	1,104,254	2,055	\$947,424 34
2	Vigo	1,041,491	1,019	581,792 57
3	Sullivan	790,609	742	398,926 09
4	Parke	784,438	982	614,163 69
5	Vermillion	659,842	541	368,818 29
6	Greene	659,161	824	367,500 52
7	Pike	173,905	437	105,831 69
8	Davies	167,209	423	110,674 21
9	Vanderburgh	152,833	209	118,028 09
10	Warrick	99,572	138	44,976 20
11	Gibson	71,634	120	41,851 23
12	Fountain	55,102	66	39,603 09
13	Knox	47,881	119	32,762 05
14	Perry	25,139	42	21,217 26
15	Martin	6,798	12	4,402 85
	Total	5,839,863	7,739	\$3,800,972 39

But few of the mines operating less than ten men made a report to the State Inspector, as they are not required by law to do so. The tonnage given by those which reported was only 25,260, bringing the full amount reported up to 5,865,123 tons. This was probably 100,000 tons less than the actual output of coal for the year.

It is my opinion that the law should be so changed as to require the examination, at least once a year, of every mine operating in the State, regardless of the number of men employed. A monthly report of the output of each of these smaller mines should also be made, so that *exact* statistics relative to the coal industry would be available. Many mines employ from six to eight men, and the aggregate amounts to a large number. The life of any one of these men is as valuable as that of a man working in the larger mines, yet under the present law they receive no protection whatever. The air where they work is often extremely foul, man-shafts are more often lacking than present, and too little attention is given to the condition of the roof. Some of these abuses could at least be ameliorated by the occasional visits of an inspector invested with power to better the conditions where possible.

Owing largely to the efficiency of the supervision of the Mine Inspector and his deputy, the number of fatal accidents during 1899 was but 15, or less than any year since 1891.

RESOURCES OTHER THAN FUELS.

LIMESTONES.

For its output of ornamental and building limestone, Indiana is the most important State in the Union. The Indiana oölitic stone has long been known among architects for its strength and durability. Within the past decade the demand for it has been rapidly increasing, and it is now in use in 27 states, one territory and one foreign country. Four State capitol buildings, those of Indiana, Illinois, Georgia and New Jersey, have been constructed wholly or partly from it, as have also 27 court houses in Indiana, and numerous custom houses, postoffices, hotels and other public buildings throughout the United States. The Soldiers' Monument at Indianapolis, with its magnificent carved groups of statuary, is composed wholly of it. In New York and other eastern cities it has also been used in the construction of the private residences of many of the richer citizens. Its wide reputation is due to its general usefulness in masonry, ornamentation and monuments; its abundance; the ease with which it can be quarried and dressed, and its pleasing color and durability.

This stone is found in a strip of territory from two to fourteen miles in width which extends from Greencastle, Putnam County, to the Ohio River. It occurs in a stratum varying from a few feet to nearly 100 feet in thickness. This stratum is massive, often without an interruption from top to bottom, and the size of the blocks which may be quarried is limited only by the capacity of the quarry machinery and transportation facilities.

The principal quarries of this stone are located near Romona, Owen County; Stinesville, Ellettsville, Bloomington and Sanders, Monroe County; Oölitic, Dark Hollow and Bedford, Lawrence County; Salem, Washington County, and Corydon, Harrison County.

Few building stones are more accessible than the Indiana oölitic limestone. Occurring as it does in an almost horizontal position, it outcrops over a comparatively large area, with either no covering at all or one so light that it can profitably be removed. The map of the area prepared for the Twenty-first Report of this Department, shows the total length of the outcrop in Owen, Monroe and Lawrence counties to be not less than 1,600 miles. The Monon Railway traverses the area from north to south over all the productive part, and there are also three east-west railroads and a short line known as the Belt, which serves to connect many quarries around Bedford with the other roads. There are also short branch roads, making switch connections with one or more of these roads, running into each of the quarries.

The oölitic stone is a granular limestone, or calcareous sand rock in which both grains and cementing principle are carbonate of lime. In the common sandstones of the State the grains are hard and nearly angular. In the oölitic stone they are always soft and either round or rounded, and the cement is harder than the grains. In color the stone is either buff or blue. Its specific gravity is about 2.47, and its weight about 152 pounds per cubic foot. In chemical composition it is nearly pure carbonate of lime, the *average* of eight analyses of specimens from the eight leading quarries showing the following percentage composition: Calcium carbonate, 97.62; magnesium carbonate, .61; iron oxide and alumina, .36; insoluble residue, .91. The crushing strength of 50 specimens ranged between 4,500 and 13,200, with an average of 7,000 pounds per square inch.

The fire resisting properties of the oölitic stone are also very great, as a series of experiments on one-inch cubes by this Department has proven. Heated to 1,000° F. and plunged into cold water, the cubes were not affected. Heated to 1,200° F. and plunged into cold water, the cube crumbled slightly along the lower edges. Heated to 1,500° F. and cooled in air, the cubes retained their forms intact but were calcined in a marked degree. This shows that the stone will withstand the effects of fire to the point of calcination.

On account of its softness when first quarried, the oölitic stone can be readily sawed or carved into any form desired. The saws in use at the various mills are almost entirely the common gang saw with long iron blades made to swing to and fro across the stone, sand and water being fed under each saw automatically.

The larger part of the stone shipped is used for fine dimension stone for buildings, both for face work and trimming. It is also largely used for monumental purposes, either as bases for monuments or for the shafts, or both. Large quantities are used for pavements, curbing, sewer piers, abutments, etc. It makes a strong and durable pavement, and does not wear slippery. Its use for curbing for cement walks is increasing year by year in many of the larger towns of Indiana and adjoining states. Large quantities of the spalls and waste pieces from the quarries are also annually used for railway ballast, or are crushed into macadam for country roads.

It is by far the most valuable stone in Indiana, and many good deposits are as yet undeveloped. For a detailed account and maps of the area containing the oölitic stone, and also full data relative to its production for the market, the reader is referred to the paper by Messrs. Hopkins and Siebenthal in the Twenty-first (1896) Annual Report of this Department.

In the vicinity of Osgood, Ripley County; Westport, New Point and St. Paul, Decatur County, and Laurel, Franklin County, are extensive beds of Niagara limestone, which for many years have been extensively quarried. This is known as the Laurel limestone, since the stone is typically exposed and has been longer worked near the town of that name.

This stone can be quarried more easily and at less expense than any other stone of a similar nature in the State; the natural seams and even bedding doing away largely with the necessity for drilling and blasting. The stone occurs in natural slabs of a uniform thickness—two to twenty inches—and with the upper and lower surfaces very even, so that for many purposes tool dressing after quarrying is not necessary. It is of a handsome color, very hard and durable, and is used extensively for flagging and curbing, and to a less extent for window sills, window caps, range stone, ashlar, doorsteps, foundations, street crossings, gutter stone, pier footings, bridge abutments, etc. For many of these uses it is better suited and can be furnished more cheaply than either the Indiana oölitic limestone or the Berea (Ohio) sandstone, the two materials with which it comes in closest competition.

The railway facilities, especially about Laurel, have been recently improved, switches having been laid to some of the best deposits. This stone can therefore be put on the market for a lower price, and yet with a greater profit than in the past, when it was hauled to the cars on wagons. Its superior quality will doubtless soon lead to its more extensive adoption for those purposes, above enumerated, for which it is so well adapted.

A somewhat similar stone, well fitted for curbing, flagging and paving, and occurring, as does the Laurel limestone, in layers of variable thickness, has been quarried in the immediate vicinity of Wabash, Wabash County. The deposits are large, easily and cheaply quarried, and worthy of much more extensive development.

Limestones for macadam, concrete and other purposes for roads and streets occur in many localities in central and southern Indiana.

One of the most extensively worked deposits is at the
Macadam Kenneth quarries, three miles west of Logansport on
Stone. the State Line Division of the Pennsylvania Railway.

Thousands of tons of crushed stone are shipped from there to Chicago for street purposes. The Illinois Steel Company draws on this quarry for much of the limestone used for fluxes in their enormous steel plant.

Two crushing plants have been recently established at Monon, White County, and are doing a large business in making macadam of the Lower Helderberg stone outcropping in abundance at that point.

At Kokomo, J. B. Carter & Son crush and ship enormous quantities of hard, bluish limestone, which has proven very durable and excellently suited for concrete work. An analysis of an average sample of their output shows it to be composed of calcium carbonate, 89.32 per cent.; magnesium carbonate, 5.27 per cent.; silica, 3.37 per cent.; iron oxide, etc., 1.63 per cent.

Other large plants for crushing macadam material are in operation at Greencastle, Putnam County; Romona, Owen County; Mitchell, Lawrence County, and Milltown and Marengo, Crawford County.

The use of crushed stone for macadam and concrete work is constantly growing, and the business of preparing the stone for such uses will, in the near future, become a most important industry in many localities of the State. The Niagara, Lower Helderberg, Oölitic and Mitchell limestones are in general well suited for macadam, and there are many localities where these stones outcrop in quantity close to a railway, which offer excellent sites for the investment of capital.

In the vicinity of Huntington, Huntington County; Delphi, Carroll County, and Logansport, Cass County, deposits of Niagara limestone are found which are especially suited for the production of lime for building purposes. At Huntington and Delphi the manufacture of lime is carried on on an extensive scale, the value of the yearly output at the two points approximating \$250,000. The product is noted through the eastern United States for the excellence of its quality, and is much sought after by builders and contractors.

The oölitic limestone of southern Indiana has not proved itself fitted for the production of lime, but a formation immediately overlying the oölitic has been extensively used, and large kilns are now producing from it a good quality of lime at Mitchell, Lawrence County, and Romona, Owen County.

The following table shows the production of limestone in Indiana in 1898, and the uses to which it was put:

Building purposes	\$1,083,571
Paving and road making.....	253,731
Riprap	16,046
Made into lime.....	195,040
Flux	138,184
Total	\$1,686,572

SANDSTONES.

Sandstones of excellent quality and in commercial quantities occur at a number of localities in western and southwestern Indiana. These sandstones are classed under two heads. First, the *Mansfield Sandstone*, occupying a strip from two to ten miles or more

The Mansfield Sandstone. in width, extending from the north part of Warren County 175 miles in an east of south direction to and beyond the Ohio River. While the Mansfield sandstone is soft, friable and easily worked, it hardens by exposure and becomes in time one of the most durable rocks in the State.

In this sandstone the mass of the rock is made up of white or colorless quartz grains embedded in a matrix or cementing substance consisting almost wholly of iron oxide. When the percentage of this iron oxide is high the stone is a handsome *dark brown* in color and is especially suited for business blocks, and for the lintels and cornices of buildings whose fronts are constructed of pressed brick. The rain never discolors small portions of such stone, and the brick walls are therefore permanently free from those unsightly, mouldy-looking streaks which soon appear where limestone is used for finishings.

This brown variety of the Mansfield sandstone has been quarried at Hillsboro, Fountain County; near Green Hill, Warren County; Mansfield, Judson and Portland Mills, Parke County, and St. Anthony, Dubois County. Good brown stone in suitable position for quarrying, but not yet developed, occurs near Bloomfield, Greene County, and on Rocky Fork and Sugar Mill creeks in Parke County. Smaller outcrops of less importance occur elsewhere.

Specimens of this brown stone from six of the leading deposits in the State have been analyzed by this Department, and their *average* composition was found to be as follows:

	<i>Per cent.</i>
Insoluble residue—silica	90.39
Alumina .....	.49
Iron oxide	7.41
Lime .....	.08
Carbonic acid .....	.09

When the percentage of iron oxide in the cementing material is low and the iron is in the hydrous form, the color of the sandstone is *gray* or *buff*. Such stones are more common than the brown variety, and are well fitted for bridges, foundations, retaining walls, or, when of the best quality, for fronts of business blocks. These buff and gray varieties of the Mansfield sandstone have been quarried at and near Williamsport, Warren County; Attica, Rob Roy, Stone Bluff, Hills-

boro, Wallace, and elsewhere in Fountain County; Guion, Judson, and several different localities along Raccoon and Sugar creeks in Parke County, and at numerous small quarries throughout the area further south.

In the upper coal measures, overlying or at a horizon above that of the Mansfield sandstone, are several beds of sandstone which are extensively quarried in the coal bearing counties of the State. In composition these coal measure sandstones are finer grained than the Mansfield sandstone, and the cementing matrix is more complex, being composed of a mixture of clay, silica, decaying feldspar and iron oxide. These stones are buff, blue or gray in color, and have proven durable wherever used. The largest quarries are at Worthy, Vermillion County; Riverside, Fountain County, and Cannelton, Perry County. The stone from Worthy has been used extensively in Chicago for side-wall fronts and trimmings, and with it public buildings in several towns of Illinois have also been built.

*Coal
Measure
Sandstones.*

The stone at Riverside is very fine grained. It takes a smooth finish and is light blue or drab in color, and well adapted for delicate carving and ornamentation. It has a crushing strength of 6,000 pounds per square inch, and a chemical analysis shows the percentage of its composition to be: Silica, 93.16; alumina, 1.60; iron oxide, 2.69. It has been largely used at Lafayette and neighboring towns. A somewhat similar stone of the subcarboniferous formation, which has been used for bridges, foundations, etc., has been quarried near Attica, Fountain County; Raccoon and Bainbridge, Putnam County, and other points in the State.

The oldest and largest sandstone quarries in the State are those near Cannelton, Perry County. The stone varies in color from a lemon yellow to a light or dark gray. Its percentage composition is as follows: Silica, 96.18; iron oxide, 1.56; alumina, .54; lime, .15. It has proven very durable but its color is not an attractive one for fine buildings, owing to the iron oxide weathering to a rusty yellow tint. It has been extensively used for building purposes at Cannelton; in the locks on the canals at Louisville, Ky., and on the Green River, Kentucky; and for wharves, retaining walls, etc., at many places along the Ohio River.

Other deposits of sandstone which have been quarried on a small scale, occur near Rockport, West Baden, Paoli, Brazil, Coxville and Covington. Some of these, as well as many hitherto undeveloped deposits are sufficient in quantity, and in quality suitable to merit the careful attention of capitalists in search of good investments.

The following table gives the value of the sandstone output in Indiana for the years 1890 to 1898 inclusive:

1890.....	\$48,983	1895.....	\$60,000
1891.....	90,000	1896.....	32,847
1892.....	80,000	1897.....	35,561
1893.....	20,000	1898.....	45,342
1894.....	22,120		

CLAYS.

The clays of Indiana rank in value next to coal and building stone, among the natural resources of the State. It is only within the past five years, however, that capitalists have come to realize to some extent the vast possibilities which the clays and shales of western Indiana present for manufacturing purposes. Even yet but few of the main deposits are being worked, and there is room for twenty times as many factories as are now in operation. During the past two years all factories have had many more orders than they could fill, and, on account of the rapid advance in the price of lumber, the future of the clay industry is a most promising one.

At the present time Brazil, Terre Haute, Clinton, Veedersburg, Montezuma, Cayuga, Hobart and Porter are the principal seats of clay industries in the central west and northwestern parts, while important factories are located at New Albany, Huntingburg and Evansville in the southwest. In the eastern half of the State there are few, if any, clays suitable for other purposes than ordinary brick and drain tile.

The purest clay in Indiana is the kaolin of Lawrence and Martin counties. The best grades of it are pure white, and show a chemical analysis of 98.61 per cent. silicate of alumina, and but 1.47 per cent. of fluxes. The poorest grades are yellowish brown in color, but even they contain no more than 3 per cent. of iron oxide and but 5 or 6 per cent. of all impurities combined.

The great drawback to this kaolin is its lack of plasticity. Otherwise it would be in every way suitable for the best grades of porcelain ware. It is, however, suitable in the highest degree for the manufacture of alum salts for the sizing of the finer grades of wall and letter paper. Its refractory properties are also very great, and for that reason, if mixed with a small percentage of the under-clays of the nearby coal measures to render it more plastic, it can be used for making the finer grades of refractory wares, such as retorts, glass pots, glass tanks, etc. Recent experiments have proven it also suitable for making a filler for furniture and buggies; for cosmetics and for ultramarine.

At the largest known deposit, four miles north of Huron, Lawrence County, thousands of tons of this purest of clays can be seen, comprising a stratum 5 to 11 feet in thickness; yet, since 1891 not a pound has been put to use. A great mineral resource of untold value—there it lies, unworked, unutilized, awaiting only the coming of energy and capital to make it up into many kinds of products which are now brought into our State from other lands.

Next to the kaolin in purity is the fire-clay of Vermillion county, found just west of Montezuma and north of Hillsdale, in the hills bordering the Wabash River. It is a high grade, whitish silicious under-clay, showing 98.24 per cent. of clay-base and sand, and but 1.79 per cent. of fluxes. It is found in a stratum five to seven feet in thickness which underlies an area a mile wide and extends from Hillsdale almost to Newport. Coal of good quality both overlies and underlies the fire-clay, the latter outcropping on the sides of the ravines.

Fire-brick made from this clay have been used for years in the iron and steel furnaces at Birmingham, Alabama, and Atlanta, Georgia, and the Illinois Steel Company, at South Chicago, has recently begun the use of the unburned clay as a lining for their furnaces. Recent shipments in quantity have also been made to Milwaukee, New Orleans; Dayton, Ohio, and Old Mexico. The brick sell for \$12.00 per thousand, and the ground clay for \$1.50 per ton on board the cars at Hillsdale.

But two factories, working on a small scale, are at present engaged in making fire-brick and marketing this clay. Taking into consideration its quality and the facilities of fuel and transportation, there is room for an investment of large capital in its development, with the assurance of a handsome profit in the future.

"Gannister," or gannister rock, a peculiar mixture of fire-clay and sandstone, occurs in quantity on the farm of Geo. Galloway (Sec. 4, T. 20 N., R. 8 W.), near Fountain, Fountain County, Indiana. Samples of this deposit were tested by the Union Steel Company, of Alexandria, and found to be in every way suitable for the lining of Bessemer and other steel converters.

Potter's clays of good quality are found in a number of localities in the coal bearing counties; notably near Huntingburg, Dubois County; Cannelton, Perry County; Loogootee and Shoals, Martin County; Clay City, Poland, and Brazil, Clay County; Coal Bluff, Vigo County, and Annapolis, Parke County. All of the deposits have been tested in a small way in manufacturing pottery for the local markets, and all have

given excellent satisfaction. The best known deposits and the ones heretofore most extensively worked are those at Huntingburg and Cannelton. The clays from these two points show the presence of 95.16 per cent. of clay base and sand, and 5.20 per cent. of fluxes. The average analyses of the clays used in the great potteries at Akron and Zanesville, Ohio, give 94.65 per cent. of clay base and sand, and 4.54 per cent. of fluxes. The potter's clays of Indiana are thus shown to be as good as those of Ohio, and the fuel supply and transportation facilities are, in many localities, better. A good slip clay for glazing pottery occurs in abundance along Rocky Run, four and one-half miles west of Rockville, Parke County.

Millions of tons of shales and underclays, well fitted for making the best grades of paving brick, sewer pipe and other vitrified products, exist in the coal bearing counties of Indiana. These clays lie in

*Shales and
Under-Clays
for Vitrified
Products.*

the closest proximity to the fuel necessary to burn them; the shales immediately overlying, and the under-clays, as their name denotes, underlying the veins of coal. No more durable material for the making of pavements can be used than vitrified brick, provided sufficient care be taken in the structure of the foundation upon which the brick are placed. Such a pavement comes nearer than any other to a typically perfect pavement; i. e., one which is reasonable in first cost; low in cost of maintenance, and easy of repair; durable under heavy traffic with reasonable freedom from noise and dust; free from decay, water-proof and non-absorptive; of low tractive resistance and furnishing a good foothold for horses.

The city of Chicago has recently let the contract for 66 miles of vitrified brick pavements, and a number of miles of brick roadways were constructed in 1899 in the country near Monmouth, Illinois. The making of paving brick is an industry yet in its infancy in Indiana, for the time will come, and that before many years, when not only the streets of every town of two thousand inhabitants within our State will be paved with brick, but also many of our country roadways in those regions devoid of gravel and other road material.

Numerous chemical analyses published in the Report of this Department for 1895, as well as the practical making of the products in many factories, have proven that the under-clays and shales of the coal regions can be made into the best of sewer pipe, roofing tile, terra cotta, hollow brick, stone pumps, conduits, pressed front brick, etc. Since 1891 thirteen large factories have been erected at Brazil, Terre Haute, Clinton, Veedersburg, Cayuga and Montezuma for utilizing these shales and under-clays. These factories have all been kept very

busy—even during the dull seasons of 1895 and 1896—the demand for their products being in many instances far greater than the possible supply. They have proven that the shales and under-clays of the coal measures are in every way fitted for manufacturing each of the products above mentioned. These factories are but the forerunners of others yet to come, for the raw material is there, the fuel necessary to burn it is there, railway facilities for bearing away the finished product are plentiful, and where these three necessary elements are present, capital is, in time, sure to come, to be invested and to make this section of the State a great clay industrial center.

The best deposits of unworked shales and under-clays for making vitrified products lie just east of Mecca, Parke County, west of Montezuma, Parke County, west of Terre Haute, Vigo County, and near Riley, Vigo County. In these localities railways are already constructed, coal is plentiful and the raw material can not be excelled in variety and quality. Other large deposits of shale which are as good in quality as those mentioned, but which at present lack railway facilities, are located on Coal Creek, one mile southeast of Veedersburg; on Brouillet's Creek, south of Clinton, Vermillion County; in section 6, Pierson Township, Vigo County, seven miles southeast of Terre Haute; near Patricksburg and Woodside, Owen County, and near Farnsworth, Sullivan County. A fine deposit of knobstone shale, whose analysis shows its fitness for vitrified products, lies alongside the B. & O. S. W. Railway six miles west of Seymour, Jackson County.

In the northwestern part of the State, near Hobart, Lake County, Chesterton, Porter County, Michigan City and South Bend, are extensive deposits of silty clay, which is peculiarly fitted for the making of terra cotta lumber. This lumber is made by mixing one part of sawdust with three parts of clay, and then forming a hollow brick a foot square, and two, four or six inches in thickness. After burning, the ware is left very light and porous, but strong and wholly fire-proof. It can be sawed like a pine board, is penetrated easily by nails, and on it plaster can be spread without intervening laths, or to it wooden finishing can be readily united. It is coming into rapid demand for wall partitions in fire-proof buildings. Floor arching, wall furring, column and girder covering and under-roofing to which slate or roofing tile can be nailed, can also be made of this same porous material. One factory has been making these products at Hobart for ten years, and the average profits of the owner have been \$20,000 per annum. He claimed to have the only deposit of clay in the State suitable for making the material, but investigations and chemical analyses made by this Department proved the presence of a great abundance of simi-

*Clays for
Terra Cotta
Lumber.*

lar raw material, and capital invested at any of the points mentioned will realize a handsome profit in the making of porous fire-proof products, which will be extensively used in the next ten years.

Clays suitable for burning ordinary building brick and drain tile occur in quantity in almost every county in Indiana. In the northern

Clays for Ordinary Brick and Drain Tile.

part of the State they are largely of drift origin, and some care has to be taken to choose those free from limestone pebbles. Within the past two years large factories have been erected near Martinsville, Montezuma and Brazil, for making ordinary brick from shale.

These factories have been successful from the start, and in 1899 could not supply the demand for their output.

The following table shows the

CLAY PRODUCTS OF INDIANA FROM 1895 TO 1898, INCLUSIVE.*

	1895.	1896.	1897.	1898.
Brick :				
Common—				
Quantity	319,751,000	262,936,000	224,042,000	277,136,000
Value	\$1,488,370	\$1,207,247	\$1,012,547	\$1,359,596
Average per M.....	\$4 65	\$4 59	\$4 52	\$4 91
Pressed—				
Quantity	17,085,000	9,071,000	8,394,000	9,883,000
Value	\$161,336	\$99,954	\$94,935	\$101,935
Average per M.....	\$9 44	\$11 01	\$11 31	\$10 31
Vitrified.....				
Quantity	22,313,000	18,792,000	27,239,000	28,216,000
Value	\$204,000	\$ 75,870	\$286,638	\$264,796
Average per M.....	\$9 14	\$9 35	\$9 78	\$9 38
Fancy or ornamental—value.....	\$13,439	\$36,060	(a)	\$9,437
Fire brick—value	\$12,510	\$28,350	\$24,245	\$29,766
Drain tile—value	\$820,602	\$475,919	\$559,524	\$622,198
Sewer pipe—value	\$42,000	\$125,839	\$156,450	\$134,980
Ornamental terra cotta—value.....	(a)	(a)	(a)	\$43,100
Fireproofing—value	(a)	\$136,461	\$121,835	\$74,629
Tile, not drain—value.....	\$139,463	\$175,390	\$223,750	\$247,990
Pottery :				
Earthenware and stoneware—value.	\$111,900	\$51,345	\$29,725	\$42,742
Miscellaneous—value	\$123,990	\$162,100	\$222,660	\$280,343
Total value	\$3,117,520	\$2,674,325	\$2,712,309	\$3,211,512

* From Twentieth Ann. Rep. U. S. Geol. Surv., 1898-99, Pt. VI, p. 59.

(a) Included in miscellaneous.

CEMENT RESOURCES.

The cement industry in Indiana is a growing one, and promises much for the future. Two kinds of cement are manufactured in the State. Hydraulic rock cement is made in large quantities in Clark County, and just across the river at Louisville, there having been 2,040,000 barrels, valued at \$816,000, produced in this district in 1898. With the exception of New York, this was more than double the amount produced in any other State, and was one-fourth the entire amount produced in the United States.

Large unworked deposits of hydraulic limestone, suitable for making this cement, occur in Scott and Jennings counties, and a similar deposit has been recently discovered near Laurel, Franklin County.

The Portland cement industry promises even greater results than that of the hydraulic cement. Portland cement is made from carbonate of lime and clay—about 78 per cent. of the former and 22 of the latter—intimately ground and mixed and then burned into a clinker and reground. The burning is mostly done in rotary steel kilns. A plant with an output of 500 barrels daily, complete with machinery up to date, will cost, approximately, \$150,000.

No mineral industry in the United States has grown more rapidly during the last eight years than that of the manufacture of Portland cement. In 1891, 454,813 barrels were made in this country, while 2,988,313 were imported. In 1898 the home production had risen to 3,692,284 barrels, valued at \$5,970,773, while the imports were 2,013,818 barrels, showing a total consumption of 5,706,102 barrels. But 2,500 barrels were made in Indiana in 1898, there being but one small factory, located at South Bend, in operation in the State.

The carbonate of lime used in the production of Portland cement is either marl or limestone. Of the production in the United States in 1898, 3,112,000 barrels were made from limestone, and 580,000 barrels from marl.

Marls for Portland Cement. Marl of excellent quality is found in abundance in the northern third of Indiana. It occurs in the vicinity of lakes, either present or extinct, and is probably due, in large part, to deposits from calcareous springs, the waters of which contain much lime in solution.

A rapid reconnoissance of the marl bearing lakes and marshes of northern Indiana was made by this Department in the fall of 1899. The region in question contains several hundred lakes with areas of from several square miles each down to a few acres. With hardly an exception these lakes contain deposits of marl. In most cases these

deposits are too small to be workable except on a very small scale. A deposit of 40 acres, three feet thick, is sometimes considered workable. On the large scale on which most of the cement factories are being built at present a deposit, to be considered workable, should be equivalent to 200 acres of marl, 10 feet in thickness. Such a deposit, of proper chemical composition, and not too far from a railroad, may be considered a *first-class* deposit, warranting the erection of a plant with a capacity of 1,000 or more barrels a day. Such deposits were noted at the following places:

Fish Lake in Laporte County, close to the Grand Trunk and Wabash railroads.

Chain and Bass lakes, west of South Bend, St. Joseph County, close to the Lake Shore and Vandalia railroads. The quality of marl here appeared to be below the average.

Lake Maxinkuckee, close to Vandalia Railroad. Deposit in lake, and principally in 10 feet or over of water. The marl is over 22 feet in thickness in places.

Simonton, Mud and Cooley lakes, northeast of Elkhart, Elkhart County. Four miles from Lake Shore Railroad.

Syracuse Lake, at Syracuse, Kosciusko County, on B. & O. Railroad. Marl in places over 36 feet in thickness.

Turkey or Wawasee Lake, on B. & O. Railroad. Contains, probably, the largest deposit in the State.

Milford and Dewart lakes, southeast of Milford, Kosciusko County. Near Big Four Railway.

Tippecanoe Lake, Kosciusko County, four miles from Big Four Railway. This lake contains considerable good marl, but the location is not so desirable on account of the deposit being strung along a long shore line.

Grass Lake, southeast of Lagrange, Lagrange County. A dry deposit, 200 acres, over 30 feet deep.

Whitmer, Atwood, Long, Third and Dallas lakes, northwest of Wolcottville, Lagrange County, close to Wabash Railway. These lakes contain a very fine deposit, but it is also along a long shore line.

Turkey and Little Turkey lakes, Lagrange and Steuben counties, contain several hundred acres of marl over 10 feet, and reported up to 45 feet, in thickness.

Lake James, northwest of Angola, Steuben County, and $2\frac{1}{2}$ miles from Ft. Wayne branch of Lake Shore Railroad, contains a large deposit, which is also much strung out.

At three of the above localities, namely, Syracuse Lake, Milford and Dewart lakes, and the Turkey lakes of Lagrange and Steuben counties,

large cement factories are, at the present writing, in process of erection, while options on a number of other deposits have been secured by parties who hope to form companies for their development in the near future. At many other localities deposits not so close to railways or not so large as those mentioned were found. Full details of all deposits of workable size, together with maps of the lakes, will appear in the next annual report. It is only necessary to say in this connection that northern Indiana can, if called upon, furnish marl sufficient to supply material for making Portland cement for the entire United States for many years to come.

On account of the absence of lakes, southern Indiana possesses no deposits of marl, but that portion of the State contains beds of oölite and oölitic limestone, suitable in every particular for the manufacture of Portland cement.

The oölitic stone of Lawrence, Monroe and Owen counties has been tested and found to make Portland cement of a superior quality.

Briquettes, after 30 days, showed a tensile strength of more than 700 pounds. The oölitic stone contains from 93 to 98 per cent. carbonate of lime, and is almost free from magnesia, the element most harmful in the manufacture of cement. Millions of tons of spalls and refuse pieces of this stone, unfit for building purposes but in every way suited for cement manufacture, are thrown aside yearly from the leading quarries. The stone, when first quarried, is soft, and much more easily ground than is generally supposed. Lying, as it does, adjacent to fuel, the shales and other clays of the coal bearing counties to the westward, there is no reason why this oölitic stone region should not become the center of the Portland cement industry in Indiana.

Large beds of oölite, which is whiter and much softer than oölitic limestone, occur at Milltown and Marengo, Crawford County, right by the side of the "Air Line" Railway. The bed at Milltown as exposed, is 13 feet thick and 1,500 feet in length, when it disappears in the bluffs of Blue River. An analysis showed the oölite to contain 99.18 per cent. carbonate of lime. It is, therefore, purer than oölitic limestone, and, being softer, the expense of the preparatory grinding will not be so great. Good clay can be secured at Huntingburg and other points to the westward on the "Air Line" Railway.

TRIPOLI.

Tripoli or infusorial earth occurs at a few localities in Indiana. A large deposit which was formerly somewhat extensively worked is found near Ferdinand, Dubois county, on the land of Joseph Brinkman. It is a fine-grained, highly siliceous product of excellent quality, but lack of capital and transportation facilities have put a stop to its development. Another extensive deposit, darker in color and showing the presence of 83.71 per cent. of silica, 8.92 per cent. of alumina and 1.54 per cent. of iron oxide, was found in September, 1899, on the farm of A. H. Harbaugh, near Freetown, Jackson County.

Tripoli is used mainly as a polishing powder for brass and other metal work; also as an absorbent of nitroglycerine in the manufacture of dynamite, and as a protective packing about steam boilers. Three thousand eight hundred and thirty-three short tons, valued at \$22,835, were produced in the United States in 1898.

"Drift marl," a very fine grained silty clay containing 40 per cent. or more of calcium carbonate, and valuable as a polishing powder, occurs in quantity on the farms of Marion W. McCann, near Rushville, and David B. Wilson, Carbon, Clay County; also near Gosport, Owen County, and Boone Grove, Porter County.

MINERAL PAINTS.

Minerals suitable for making paints are found in quantity in several places in southern Indiana.

In section 6, Pierson Township, Vigo County, there is a large deposit of very fine grained, grayish shale, known as the "Paint Mine." For a number of years this has been ground and shipped in barrels to be used as a body for paints. It serves the purpose admirably, and a lack of capital and transportation facilities alone have prevented the development of the industry on a larger scale.

On the land of Chas. Grimes (Sec. 20, T. 9, R. 5), Jefferson Township, Owen County, three miles east of the E. & I. Railway, is a large deposit of iron oxide suitable for a mineral paint. A similar deposit of finer texture occurs near Worthington, Greene County.

One mile west of Dover Hill, Martin County, is a bed of ferruginous shale and clay, 15 feet and more thick, which furnishes umber, and red and yellow sienna of excellent quality. When Dover Hill was the county seat of Martin County, this deposit was extensively worked, but on account of a lack of transportation facilities it has, for many years, remained untouched.

Near Ferdinand, Dubois County, in the S. $\frac{1}{4}$ Sec. 34, T. 3, R. 4, are extensive beds of red oxide of iron and clay which, about 1870, were

worked on a large scale. Paints of a dozen or more different colors were made which were highly esteemed for their beauty and durability. A lack of capital and shipping facilities, however, in time put a stop to the enterprise. Large deposits of ochre and other paint clays are found farther south in the same region.

Deposits of a ferruginous clay suitable for umber also occur in quantity near Dillsboro, Dearborn County.

WHETSTONE AND GRINDSTONE ROCKS.

The fine-grained siliceous rocks in Orange and Martin counties have long been used for the manufacture of abrasive materials. In the annual report for 1895 issued by this Department was an extensive paper on the whetstone and grindstone industry of the State, prepared by Mr. E. M. Kindle. This was accompanied by an accurate geological map of the area mentioned. The principal quarries are near French Lick, Georgia, Orangeville and Paoli.

Indiana ranks second among the states of the Union in the production of whetstones and grindstones, being excelled only by Arkansas. The output of this State is not large, being in 1898 but 320,000 pounds, valued at \$15,000. The demand, however, is constantly increasing, and if better railway facilities were provided the industry would soon become a prominent one in the area which contains the raw material.

MOLDING SAND.

Molding sand for use in foundries occurs in a number of places in northern and central Indiana. The best known deposit is near Centerton, Morgan county. Other beds, extensively used in Chicago, are located near McCool, Porter County, and four miles southeast of Valparaiso in the same county. Near Hobart, Lake County, is a fine deposit $8\frac{1}{2}$ feet in thickness and covering a large area, which is, as yet, unworked. Other good deposits are found near Gosport, Owen County; Salem, Washington County, and Rockport, Spencer County.

GLASS SAND.

Sand suitable for glass making is found in quantity near Pendleton, Madison County; Montpelier, Blackford County, and Lapel, Hamilton County. These deposits are largely used by the glass factories in the gas belt. A large deposit, as yet but little developed, occurs near Wolcott, White County.

On Sec. 15, T. 14 N., R. 8 W., one-half mile east of Coxville, Parke County, is also a large deposit which in the past few years has been shipped in quantity for use in window glass making at Muncie, Orestes

and other points. A switch from the T. H. & L. Railway is laid to the deposit, and a branch of the C. & E. I. runs within a half a mile. Three analyses of this sand showed its average composition to be as follows: Silica, 98.77; iron oxide, .685; calcium carbonate, .426; magnesium carbonate, .113. At the point where produced, this sand is 40 feet thick. The deposit extends for a mile or more along the bluffs of Raccoon Creek, and, in most places, is underlain with a four-foot vein of good coal.

IRON ORES.

Limonite, brown hematite, siderite and pyrites are the ores of iron occurring in Indiana. Limonite or bog iron ore is found in largest quantities in Greene, Martin, Monroe and Perry counties in the south, and in the swamps of Lake, Porter and St. Joseph counties in the northwest. In general it is too siliceous to compete with the richer hematites of the Lake Superior, Missouri, Tennessee and Georgia iron regions. As a proof of this, it is only necessary to state that of fourteen blast furnaces which have been erected in the State in the past to use these bog and other iron ores, not one is in operation at the present. Most of them have long since gone to ruin, and of those still standing, the last one went out of blast in 1893.

Three miles east of Bloomfield, Greene County, are large deposits of a mixture of limonite and brown hematite which are, perhaps, the richest ores of iron in the State. The veins are from five to eight feet in thickness and cover an area of more than 1,500 acres. An analysis of this ore, probably from picked samples, made by Dr. Robert Lyons, of Indiana University, showed as follows:

	<i>Per cent.</i>
Metallic iron	55.09
Phosphorus .....	.60
Silica (free)	11.66

Samples sent to me by interested parties were submitted to Dr. Noyes, the chemist of this Department, who found that they contained 47.25 per cent. metallic iron.

The old Richland furnace, which was located two miles southeast of Bloomfield, was used in reducing these ores between the years 1841 and 1858. About nine tons of pig iron were produced daily. The closing down of the old Wabash and Erie Canal left the furnace 30 miles from the nearest transportation point, and so caused its final closing down. A semi-block coal of good quality is found in veins 2 to 3½ feet in thickness, in the immediate vicinity of this iron ore. The

Bloomfield branch of the Monon Railway is distant to the southward about two miles.

Siderite or carbonate of iron, often called kidney iron ore, is found associated with the overlying shales in most of the coal bearing counties. In western Vigo and Vermillion counties it is especially common in the shales overlying coal VII. Large quantities were formerly used in the blast furnace at Terre Haute, and in the old Indiana Furnace on Brouillet's Creek, about eight miles to the northwest.

Pyrites or iron sulphide, known also as "fools' gold," is the most widely distributed ore of iron in the State. Its constituents are iron, 46.7 per cent.; sulphur, 53.3 per cent. It is probably to be found in greater or less quantities in every county. It occurs most abundantly associated with coal VI, or coal L—the thickest vein of bituminous coal mined in the State. Hundreds of thousands of tons of pyrites have been thrown out on the dumps of the mines of this vein of coal between Edwardsport, Knox County, and Coxville, Parke County. Within the past two years this pyrites has greatly increased in value on account of the rapid rise in the price of sulphur. The pyrites is used mainly in the manufacture of copperas, or iron sulphate, and sulphuric acid; 100 tons of the pyrites being used in making 50 tons of the acid.

As usually thrown on the dumps the pyrites is mixed too largely with coal and other impurities for use. A plant or separator for freeing it from impurities can be erected for about \$2,500, and the pyrites will then bring \$2.25 or more per ton. In 1898, 143,201 tons of pyrites, valued at \$391,541, were produced in the United States, while 259,546 tons, valued at \$747,419, were imported.

Sulphuric acid is by far the most important chemical compound known to man. Sodium nitrate and pyrites are the two ingredients used in its making. The nitrate for any factory in the United States has to be imported from South America. With the pyrites and fuel present in large quantity, western Indiana offers a most excellent site for a great sulphuric acid factory.

OTHER MINERALS AND ORES.

With the exception of small quantities of drift gold, in the form of minute grains and scales, which are found in the sands and gravel beds along the streams of Brown, Morgan and other counties near the southern limit of the drift area, no gold, silver or other precious metal occurs in the State. Much money has been foolishly spent and time wasted by people who have thought otherwise; and hardly a day

passes but specimens of rock supposed to contain gold or silver are brought or sent into this office. Most of these specimens contain either pyrites of iron, commonly called "fools' gold," or scales of mica which glisten when exposed to light.

An occasional lump of lead ore or galena is sent in from some county in the State, but it, too, is of drift origin, as is also any piece of native copper found in Indiana. Zinc blende, or zinc sulphide, occurs in a few localities in the western and southwestern counties, but nowhere in commercial quantities.

A GENERAL DISCUSSION OF THE MIDDLE SILURIAN ROCKS OF THE CINCINNATI ANTICLINAL REGION, WITH THEIR SYNONYMY.

BY AUG. F. FOERSTE.

Along the Ohio River, in Indiana and Kentucky, between Madison and Westport, the top of the Lower Silurian consists of 30 to 50 feet of arenaceous limestones, forming massive layers, and weathering into steep cliffs over which plunge numerous falls. The hard stratum at the top of the cliffs consist of the Clinton or the immediately overlying Niagara rocks. The massive rock is often banded with light and dark brown and, occasionally, with purple tinges. It contains very few fossils, which usually elude discovery. They consist of Lower Silurian forms similar to those which occur in the strata below. This rock has been called by the writer the Madison bed, and was called the Cumberland sandstone by Prof. N. S. Shaler, in Kentucky. Following the Madison bed northward, it is found to change into a complex of limestone, calcareous shales, and clays, in Ripley County, Indiana; and, into shaly clays, with some clayey limestone, in Franklin County. In the northern counties of the Lower Silurian area in Indiana and Ohio, shaly clay predominates. A few layers of solid limestone are found at various horizons, and these are at times quite fossiliferous. Along the eastern counties of the Lower Silurian area in Ohio, a large part of the shales are replaced by soft clays, whose prevailing color is light blue, but which are often mottled with light purple.

Tracing the Madison bed southward into Kentucky it soon loses its color banding, and presents a more even brown color. Its layers are no longer as massive; the separate courses being often only a few inches thick. It is still the seat of waterfalls, but it disintegrates less rapidly, and forms less vertical banks, so that the falls are not so high; on the contrary they are often rather low. It remains, however, a sandy limestone, varying locally towards shaly limestone. Even in the most southern exposures in Lincoln and Casey counties, Ken-

tucky, it does not resemble a sandstone. Northeast of these counties it becomes a more shaly, clayey limestone, and in Madison County parts of the formation weather into a brownish gritty clay.

Overlying the Madison beds, especially in various parts of Kentucky and southern Indiana, is a variable thickness of very fossiliferous Lower Silurian limestones. The considerable variation in thickness of these limestones, often within only a few miles, and, so far, best noticed in Marion County, Kentucky, suggests that the Clinton lies unconformably upon the Lower Silurian, and that this unconformity could be well established if a careful study of this problem were made. The writer was, however, not able to find anything suggesting that this unconformity was in any way related to the formation of the Cincinnati axis. If the elevation of the Cincinnati axis began in Middle Silurian times, this still remains to be proved. There is ample proof of local elevation in various parts of Indiana, Kentucky, and Ohio, but not of any connection between these elevations and the formation of the Cincinnati axis.

The Clinton in the northern counties bordering the Lower Silurian areas in Ohio and Indiana, is a crinoidal limestone, of white, pink, or reddish color. It thins out rapidly southwestward, and at the same time changes in color. In northern Franklin County it is often tinged with salmon brown, and in the southern part of the county, and in Decatur, the salmon brown color prevails. The salmon brown color is characteristic of the Clinton from Decatur County, Indiana, to western Oldham County, Kentucky, excepting along the most eastern exposures of this belt; where the Clinton is more siliceous and has a pinkish tinge.

In the short distance between Jefferson and Nelson counties, Kentucky, the Clinton changes to a series of whitish, light blue, or light brown limestones, with more or less chert in thin layers or nodules, resembling lithologically some phases of the Laurel Niagara, rather than the Clinton of more northern localities. It retains this form as far as western Marion County.

In Lincoln County, south of Stanford, the Clinton has a bluish color, and is a somewhat more siliceous limestone. Where weathered, it assumes a light brown, rather rusty brown color.

In Ohio, the crinoidal Clinton merges into a light blue limestone, with chert, in southern Clinton and in Highland counties. Farther eastward, in southern Highland County, the Clinton changes into a sandy limestone, having the appearance of a calcareous sandstone, and its color is in places a deep reddish brown.

The Osgood beds, in southern Indiana, consist of a thick layer of

shaly clay, followed by a much thinner layer of limestone, and then by more clay, the second clay bed being thin, as compared with the lower. This series may be traced southward into Kentucky, and may be recognized at Bardstown, in Nelson County, Kentucky. In the more southern exposures of Kentucky, the upper shale is often replaced by a poor quality of limestone, which can not be distinguished readily either from the Osgood limestone below, or the Laurel limestone above. The difficulty is increased by the fact that the Osgood limestone becomes more argillaceous. The lower shaly clay, which forms the main body of the Osgood, remains, however, a characteristic feature. In southern Nelson, and in Marion County, the shaly clay turns into a very soft clay in places, its color, becomes a light blue, and it increases considerably in thickness. In Lincoln County the Osgood clay is very thick, and has a light blue color; this feature it preserves in Garrard County and northward.

The lower six or twelve inches of the Osgood clay series are often replaced by thin limestones, in southern Indiana and northern Kentucky. In the most eastern exposures along the railroad, east of Bardstown, in Nelson County, Kentucky, the amount of limestone at the base of the Osgood clays increases, so that it is difficult to draw the line between the Osgood beds and the underlying Clinton. This is even more true of the exposures in Garrard and Madison counties, the limestone element at the base of the Osgood shale having increased considerably. The rather abundant presence of *Whitfieldella cylindrica*, at the base of the Osgood beds, is of considerable assistance in drawing the line between these formations. Thin limestone beds occur also above the base at various levels in the Osgood clays. This may be seen in Garrard and Madison counties.

Following the Osgood shales from the Ohio River counties, in Indiana, northwards, the upper part of the main, lower, Osgood shale becomes a poor, rotten, clayey limestone, in Ripley County, in Indiana. I have referred to it as the Madison-like bed of the Osgood series. The upper shale either disappears or becomes calcareous, so that it becomes very difficult to draw the line between the Osgood limestone and the Laurel limestone, immediately above. Going farther northward, into Fayette County, Indiana, even the lower part of the main, lower shale becomes calcareous, and turns into an inferior limestone. The whole Osgood formation is represented by various qualities of limestone, near Longwood, in Fayette County. It maintains this character, northeastward in Ohio. In Montgomery, Clark, and Greene counties, a part of this limestone, corresponding roughly to the lower, main clays of the typical Osgood sections, becomes shaly, locally. The

lowest part of the Osgood section develops into a white, hard limestone, valuable for building purposes. It is known as the Dayton limestone. It corresponds roughly to the basal Niagara, of the Indiana sections. The shaly element increases south of Greene County, and, in Highland and Adams counties, often exceeds 100 feet, and has become a genuine shale, with only an occasional limestone layer. The limestone at the top of the Osgood sections in Indiana, seems to be replaced in the more southeastern counties of Ohio by the West Union cliff rock.

It seems therefore as though the Osgood series could be readily recognized both in Indiana and Ohio, in the counties near the Ohio River. The shaly clays begin to merge into various grades of limestone in the northern half of Ripley County, Indiana, and in the northern half of Highland County, Kentucky. It is impossible to recognize the Osgood limestone as distinct from the remainder of the Osgood series north of Fayette County, Indiana, or to distinguish the West Union cliff rock north or west of Greene County, Ohio. This suggests that the Osgood series, once formed a continuous series across the present northern half of the Cincinnati anticline, and that from certain characteristics which it possessed near the Ohio River, and southward for some distance, it varied to a limestone formation on going northward. It is difficult to evade the conclusion from this that the Cincinnati anticlinal could not have been in existence at this time.

The overlying Laurel limestone, Waldron shale, and Louisville limestone of Indiana may be recognized in their most southern exposures in Kentucky, in Nelson County. In Indiana they have been traced as far north as Shelby and Rush counties. Here they change lithologically, although it is believed that it would be possible to trace the equivalent beds considerably farther north. In Ohio, the beds are represented by the Springfield and Cedarville limestones.

Before the deposition of the Devonian beds, extensive erosion removed various thicknesses of Upper Silurian and even of Lower Silurian rocks from various parts of Kentucky, Ohio, and Indiana, due to the partial elevation of the Cincinnati axis. The investigations leading up to this conclusion have been occupying the writer for several years.

During the progress of these studies it was learned that the literature of the Middle Silurian formations in the Cincinnati anticlinal regions of Indiana, Kentucky, and Ohio was often misleading. The unraveling of this literature has consumed much time, and it seems very undesirable that every student entering this field should be

obliged to take up this process of deciphering anew. Without a guide, students who depend upon the literature for many of their conclusions, are likely to be more misled than benefited by their researches. For this reason it has seemed desirable to the writer to put on record his conclusions. Whatever value they possess is chiefly due to the fact that he has seen nearly every portion of the entire field, and has been able to follow the exposures from outcrop to outcrop, rather than examining them only at widely remote localities.

SYNONYMY OF MIDDLE SILURIAN BEDS OF CINCINNATI ANTICLINAL REGION.

A.—TABLE.

A.—MADISON BEDS.

I. INDIANA.

(a) Ohio River counties.

I. Lower Silurian.

1874, 1876, Dr. W. S. T. Cornett, Jefferson County.

1879, E. T. Cox, Jefferson County.

1889, G. C. Hubbard, Jefferson County.

1897, A. F. Foerste, Ohio River counties.

(Name "Madison beds" suggested by A. F. Foerste, 1897.)

II. Upper Silurian.

1859, Richard Owen, and D. D. Owen, Jefferson County.

III. Medina.

1872, Prof. E. Orton, Jefferson County.

1872, Prof. R. B. Warder, Dearborn, Ohio, and Switzerland counties.

IV. Clinton.

1841, Trip of 1841, Prof. James Hall, Jefferson County.

1874, 1875, 1876, Prof. W. W. Borden, Ohio River counties.

1886, Maurice Thompson, quoting Borden.

1889, Prof. A. H. Young, Jefferson County, quoted by A. F. Foerste.

V. Niagara.

1876, Prof. W. W. Borden, Reuben Daily section, Jefferson County.

(Misled by changed lithological conditions.)

(b) Counties north of Ohio River counties.

I. Lower Silurian.

1869, Dr. Rufus Haymond, Franklin County.

1897, 1898, A. F. Foerste, various counties.

II. Clinton, accidentally including some Lower Silurian.

1884, Dr. M. N. Elrod, Fayette County.

1886, Maurice Thompson, quoting Elrod.

- III. Niagara.
 - 1876, Prof. W. W. Borden, Ripley County, branch of Cedar Creek.
(Misled by white color of limestone.)
- II. KENTUCKY, CUMBERLAND SANDSTONE.
 - I. Upper Silurian.
 - 1857, D. D. Owen, Cumberland County.
 - 1891, Prof. Edw. Orton, Cumberland County.
 - II. Medina.
 - 1877, Prof. N. S. Shaler (Oneida and Medina).
 - 1882-1887, W. M. Linney, Washington, Lincoln, Garrard, Nelson, Clarke, Montgomery, Mason, Bath, Fleming, Henry, Shelby, Oldham counties.
 - 1885, Dr. W. T. Knott, Marion County.
 - 1890, Dr. R. H. Loughridge, Clinton County.
 - III. Niagara.
 - 1873, Prof. J. S. Newberry, Cumberland County.
 - 1882, W. M. Linney, by mistake separated from his sandy Medina beds.
- III. OHIO, UPPER CLAYS, CINCINNATI GROUP.
 - I. Lower Silurian.
 - 1873, Prof. J. S. Newberry, southwestern Ohio.
 - 1873, Prof. E. Orton, Clarke County.
 - II. Between Lower and Upper Silurian.
 - 1878, Prof. E. Orton, Miami County.
 - III. Upper Silurian.
 - 1878, Prof. E. Orton, Warren County.
 - IV. Medina.
 - 1869-1893, Prof. E. Orton, Montgomery, Highland, Adams, Greene, and other southwestern counties.
 - 1873, 1878, Prof. J. S. Newberry, southwestern Ohio.

B.—CLINTON.

- I. INDIANA.
 - I. Clinton.
 - 1883-1884, Dr. M. N. Elrod, Decatur, Fayette counties.
 - 1896-1898, Aug. F. Foerste, southeastern Indiana.
 - II. Niagara.

The Clinton was not recognized as a distinct formation in the early reports of the Indiana survey. Hence it was placed in the basal part of the Niagara by all who considered the Madison bed as equivalent to the Medina or Clinton. The only exceptions are those mentioned above.
- II. KENTUCKY.
 - I. Lower Silurian.
 - 1898, Marius R. Campbell, by implication, at the railroad cut, half a mile south of Whites, Madison County.

II. Medina.

1882-1884, M. Linney, Washington, Lincoln, Garrard, Nelson counties.

1885, Dr. W. T. Knott, near Marion-Nelson county line.

III. Clinton.

1857, D. D. Owen, eastern counties.

1877, Prof. N. S. Shaler, eastern counties.

1884-1886, M. Linney, Clarke, Montgomery, Mason, Bath, Fleming counties.

1887, M. Linney, Oldham County; even Middle Niagara layers are included.

IV. Panola formation.

1898, Marius R. Campbell, Madison County, and neighboring counties. Forms base of Panola.

III. OHIO.

I. Clinton.

1869-1893, Prof. E. Orton, Prof. J. S. Newberry, and others.

C.—OSGOOD BEDS.

INDIANA.

I. Niagara.

The Osgood beds are not distinguished from the main mass of Niagara in any of the early reports.

II. Lower Niagara shales.

1883, Dr. M. N. Elrod, Decatur County.

1897, 1898, Aug. F. Foerste, under the name Osgood beds.

KENTUCKY—Crab Orchard shales.

I. Clinton.

1882-1886, M. Linney, all county reports.

1887, Linney, included with several other horizons in the Clinton.

II. Great Marl bed=Lower Niagara shale.

1857, D. D. Owen.

III. Niagara or above.

1877, Prof. N. S. Shaler.

IV. Panola formation.

1898, Marius R. Campbell, forms middle part of Panola section.

B. DISCUSSION OF THE LITERATURE.

A.—MADISON BEDS.

I.—INTRODUCTORY.

At the top of the Lower Silurian in many parts of Kentucky, Indiana and Ohio, are a series of sandy limestones and shales of variable thickness, nearly devoid of fossils, to which the name *Madison beds* has been given by the writer. In some localities limestones with abundant Lower Silurian fossils overlie the Madison beds, but this fact does not seem to have been recognized until 1889, when Mr.

George C. Hubbard discovered a layer of dense bluish limestone, with Lower Silurian fossils, above the Madison beds at Madison, Indiana. Indeed, fossils are found in the Madison beds, but they are sufficiently rare to have escaped attention until 1874, when Dr. W. T. S. Cornett, of Madison, Indiana, found Lower Silurian fossils at several levels near the top of these beds, thus conclusively proving their age, 15 years before the discovery by Mr. Hubbard. Previous to this year (1874), the age of the Madison beds was in doubt.

This, however, did not prevent geologists from expressing opinions as to their age, but these opinions were necessarily based upon lithological characteristics. At that time it was customary to correlate the sections presented by the rocks in the middle states with the section exposed in New York, which had been best studied. Now, in New York the richly fossiliferous Lower Silurian beds are followed first, by the Oneida conglomerate, and then by the Medina sandstone, both scantily fossiliferous; above the Medina occur the richly fossiliferous Clinton shales and Niagara limestones. In Kentucky, Indiana, and Ohio there is an abundant development of richly fossiliferous Lower Silurian limestones. Moreover, on the eastern side of the anticlinal in Kentucky and Ohio it seemed possible to easily identify the Clinton by lithological means. In some parts of New York, the upper part of the Clinton contains layers of oölitic iron ore. Overlying the sandy limestones and shales of the eastern border of the Cincinnati anticlinal in Kentucky and Ohio, which are the equivalent of the Madison beds of Indiana and neighboring Kentucky, is a limestone formation, the upper layers of which in various localities consist of similar oölitic iron ore. It was therefore correlated with the Clinton of New York. Very little was known about the fossils of this Clinton of Kentucky and Ohio until Prof. E. Orton began his labors in Ohio in 1869. To him belongs the credit of having first identified the Clinton of Ohio by means of fossils capable of forming the basis of such an identification.

The highest fossils known to be of Lower Silurian age previously to the investigations of Dr. W. T. S. Cornett were found just beneath the Madison beds. The lowest layer of the limestone associated with the Clinton oölitic iron ore was found just above the Madison bed. The Madison bed itself, which occurs between these horizons, was therefore regarded as being the equivalent of the Medina of New York, and was placed in the Upper Silurian. In Indiana, where the Clinton is often but poorly represented, the Madison bed has at times been even called Clinton.

This has given rise to a rather confused terminology for the Lower

Silurian Madison beds, which it is the purpose of the following pages to unravel.

As long ago as 1857, Dr. D. D. Owen placed the upper limit of the Lower Silurian at the uppermost beds with recognizable Lower Silurian fossils. The nonfossiliferous sandy limestones and shales (Madison) just above, were referred to the Upper Silurian. See, for instance, the old reports of the Geological Survey of Kentucky, Second Volume, 1857, pages 102, 103; and the Third Volume, 1857, pages 93, 100, 142, 147. The same method of determining the upper limit of the Lower Silurian was pursued by Richard Owen in Indiana, when, in 1859, he considered the *Favistella* bed at Madison, Indiana, as the upper limit of the Lower Silurian, and referred the overlying nonfossiliferous sandy limestones (Madison beds) to the Upper Silurian. The name Medina was not used for these beds until later.

A.—MADISON BEDS.

II.—INDIANA.

Both Indiana and Ohio renewed State geological survey operations in 1869.

In the report on Franklin County, in the First Report of the Indiana Survey, 1869, Dr. Rufus Haymond correctly placed the lower limit of the Upper Silurian at the base of the hard limestone layer (Clinton) which forms the waterfalls in various parts of the county. The underlying sandy shales are referred to the Lower Silurian (pages 177, 178, 181, 184). This correct identification of the sandy (Madison) shales was probably due to the fact that after all they are not very different in Franklin County from the shales with interbedded limestones of undoubted Lower Silurian age which occur lower down in the section at Derbyshire falls, and at other localities in the north central parts of the county.

In the river counties of Indiana, the Madison beds are typically developed. Here they consist of massive beds of limestone, of brownish or bluish color, of an evidently sandy texture, and sufficiently distinct lithologically, from the Lower Silurian still farther down, to suggest the idea that they form a distinct horizon.

In the report on Dearborn, Ohio, and Switzerland counties, in the Third and Fourth Reports of the Indiana Survey, 1872, Prof. R. B. Warder referred to the fact that Prof. Richard Owen places the *Favistella stellata* bed at the top of the Lower Silurian, and that Prof. E. Orton provisionally regarded the immediately overlying beds as Medina (pages 399, 400, 415, 418). His reference to the exposures east of Osgood, shows that he recognized the fact that Lower Silurian

fossils occurred there above the *Favistella* bed, but he did not draw the legitimate conclusion that the occurrence of Lower Silurian fossils disproves the Upper Silurian age of these rocks (page 401).

In the report on Clark and Floyd counties in the Fifth Report of the Indiana Survey, 1874, Prof. W. W. Borden referred to the Clinton Group, a gray and yellow stratified sandstone, averaging 20 feet, occurring at the summit of the ridge at Camp Creek and continuing to Marble Hill. The *real* Clinton at the localities mentioned, however, does not exceed 4½ feet. In the section at Marble Hill (page 140), the 20-foot layer of sandstone, called Clinton by Prof. Borden, is placed 66 feet above the *Murchisonia* shell marble, worked in Dean's quarry, and 26 feet above limestones with abundant Cincinnati Group fossils. The sandstone of this report can therefore be nothing but the sandy limestone described in my report on the same area under the name *Madison bed*, and is therefore of Lower Silurian age. In the general section, page 172, the same bed (Clinton of Borden) is referred to as a magnesian limestone, equivalent to the Clinton Group of New York, and overlying the Madison (of Borden) limestone. The Madison limestone of Prof. Borden is, however, not the Madison bed of my reports, but the richly fossiliferous limestone section belonging to the Cincinnati Group, which immediately underlies the Madison beds of my reports. Borden's Clinton is therefore evidently equivalent to the Madison beds of my reports. Their reference by Borden to the Clinton was probably due to Prof. Hall, who in the notes of his journey of 1841, calls the strata above the fossiliferous blue limestones at Madison, Indiana, *Clinton*.

In the report on Jefferson County, in the Sixth Report of the Indiana Survey, 1875, Prof. W. W. Borden again identified 23 feet of rock as Clinton. The section at Dog Falls (page 157) shows that this Clinton of Borden is the sandy (Madison) limestone now known to be at the top of the Lower Silurian, for the water at the falls tumbles over a ledge of real Clinton, about four feet thick. The rock below the falls is the Madison bed of my reports, and its Lower Silurian age is demonstrated by fossils found at its very summit. (See the Twenty-First Report of the Indiana Survey, 1896.) The 35 feet of Clinton rock mentioned by Prof. Borden, as occurring at Lee's Falls (page 158) the 19 to 22 feet of Clinton in Saluda Township (page 160), the 16 to 20 feet of light yellow and brown glistening sandstone (Clinton) at Crow's Falls, the Clinton at Butler's Falls and at the Chain Mill Falls, the 12 to 23 feet of Clinton on the New Pike, College Hill, Hanover, the 23 feet of Clinton along the railroad cut at Madison (pages 158 to 165), and the Clinton as identified by Prof. Borden, on

page 168, must all be considered as equivalent to the Lower Silurian *Madison bed*.

The Lower Silurian age of the rocks referred to the Clinton by Prof. Borden, is shown at Crow's Falls, Butler's Falls, the Chain Mill Falls, along the New Pike (at present the "landing road") at Hanover, and along the hills bordering the railroad cut at Madison, by the presence of undoubted Lower Silurian fossils, which at these localities occur just above the supposed Clinton beds of Prof. Borden. (See the Twenty-first Report, Indiana, 1896.) The section northeast of Mud Lick, on the land of Reuben Daily, does not show the presence of the *real* Clinton because the section was taken from a locality too far down the stream. The supposed Niagara white and gray limestone of this section, however, is the equivalent of the sandstones which Prof. Borden elsewhere calls *Clinton*; in other words, Prof. Borden's Niagara at this locality is the equivalent of the *Madison bed* of my report. (See the Twenty-First Report, Indiana, 1896.) The real Clinton and Niagara are found farther up the stream. The upper parts of the Madison bed cease to be sandy on going from Madison northward (not northeastward), and change to a limestone formation, becoming richly fossiliferous considerably farther north, in the middle parts of Ripley County. At Mud Lick, an intermediate locality, some parts of the Madison bed section are so very similar to the white limestones of Niagara age of this part of Indiana, that the mistake made by Prof. Borden during a hasty survey is readily understood.

The most curious blunder in Prof. Borden's report on Jefferson County occurs, however, on pages 159, 160, 167 and 184, where he discusses the section at Madison. This blunder caused Mr. S. A. Miller to deny the existence of the Clinton in the entire State of Indiana, and made him unwilling to recognize any species published as coming from the Clinton of Indiana, Ohio or Kentucky as being of anything but Niagara age. The blunder was made by Prof. Borden owing to the fact that he had learned from an article by Dr. W. T. S. Cornett (Indianapolis Journal, July 10, 1874), that Lower Silurian fossils extended much farther up the section at Madison than had formerly been supposed, and that on this account it was necessary to place the line of separation between the Lower and Upper Silurian at a considerably higher level. He failed, however, to recognize that the discoveries of Dr. Cornett removed all of his (Dr. Borden's) Clinton to the Lower Silurian and necessitated a revision of the nomenclature of this and immediately overlying rocks. His descriptions, therefore, show a confusion of his and Dr. Cornett's ideas. To unravel this confusion, it is best to state more fully just what were the discoveries of Dr. Cornett.

It will be remembered that Dr. D. D. Owen, in 1857, placed the upper limit of the Lower Silurian rocks of Kentucky with the uppermost fossiliferous rocks of that series. This, in a number of instances, made the *Favistella stellata* layer the top of the Lower Silurian. When, in 1862, he and his brother Richard Owen investigated the hills behind Madison they came to the conclusion that the *Favistella stellata* layer formed the top of the Lower Silurian there also. Later, Professor Orton found *Tetradium fibratum* six feet above the *Favistella* layer, and 12 to 15 feet above the *Favistella* layer were found other well-known Cincinnati Group fossils. (Ohio Survey, Vol. I, 1873, page 388.) From this latter layer, Dr. Cornett enumerates, among others, *Orthis occidentalis*, *Chætetes frondosa*, *Chætetes mammulatus* and *Ambonychia radiata*. The line of separation between the Lower and Upper Silurian was therefore removed to a level 12 feet higher. Professor Orton, having come to the conclusion that the shales and clays at the top of the Lower Silurian in Ohio were probably of Medina Age, consistently came to the conclusion that the sandy Madison beds overlying the highest fossil layer discovered by him at Madison were also of Medina age. Dr. Cornett, however, found two layers containing Cincinnati Group fossils at a level 31 to 32 feet above the highest fossil layer found by Professor Orton. Among the fossils enumerated by Dr. Cornett from these upper layers are *Orthis occidentalis* and *Ambonychia radiata*. Dr. Cornett's discoveries raised the line of separation between the Lower and Upper Silurian 34 feet. This removed the sandy limestones identified as Clinton by Professor Borden and as Medina by Professor Orton entirely from the Upper Silurian and established their Lower Silurian age. This fact was recognized by Dr. Cornett, but not by Professor Borden, who continued to call these sandy rocks *Clinton*, and did not see the bearing of Dr. Cornett's discoveries. Thus, on pages 166 and 167, of the Sixth Indiana Report, Professor Borden took from Dr. Cornett's paper in the Indianapolis Journal, July 10, 1874, a section of the rocks along the Michigan road at Madison. He varied it, however, in such a manner as to place the upper limit of the Lower Silurian at the *Tetradium fibratum* layer, and so as to place the overlying Madison bed, consisting of sandy limestones, in the *Clinton*, as he had done heretofore, notwithstanding the fact that he acknowledges the presence in his *Clinton* of Cincinnati Group fossils. Moreover, he omits the fact given in Dr. Cornett's paper that these Cincinnati Group fossils occur at the 351 foot level, in other words, at the top of his so-called *Clinton*.

Dr. Cornett's discoveries removed all sandy beds so far called

Medina or Clinton to the Lower Silurian. The presence of Medina in Indiana was therefore denied. Dr. Cornett, however, found it more difficult to admit the absence also of the Clinton. Now, it so happens that the lowest layers of the Cliff limestone of Indiana (that part of the Niagara section called the Laurel limestone in my report) which are exposed along Gale's road near the Michigan road section lie 23 feet above the top of the Madison bed, the top of what Dr. Cornett knew to be Lower Silurian. The intermediate layers constitute what I have called the Osgood beds. The Osgood beds consist of shales and shaly limestones interrupted about one-third of their thickness from the top by several thicker and firmer layers of limestone, called by me the Osgood limestone. This limestone is richly fossiliferous in Ripley and Jennings counties, and along Big Creek in the northern part of Jefferson County; even near Madison it contains quite a number of fossils. These fossils are of Lower Niagara age. Many are specifically identical with well-known Niagara fossils, or are, at least, their immediate precursors; they certainly represent later types than those of Clinton age. These 23 feet of Lower Niagara clayey shales and limestones were considered by Dr. Cornett as of Clinton age, and the Niagara fossils found in the limestone near the upper third of the section were enumerated by him as Clinton fossils. These Lower Niagara fossils, with several additional ones, are also quoted by Professor Borden as occurring in the Clinton rocks of Jefferson County (page 184 of the Sixth Annual Report). Moreover, on page 159 of the same report, Professor Borden quotes the following statement, not indicating, however, the fact that it is a quotation, without a change of word, from Dr. Cornett's paper: "The upper and lower strata of the Clinton are non-fossiliferous. The fossils which characterize this formation are to be found at or near its upper third. They are so compactly cemented in the rock that it is in most instances impossible to isolate them, consequently they have to be studied in fragments. I recognize the following: *Zaphrentis bilateralis*, *Fenestella prisca*, *Atrypa reticularis*, *Illænus insignis*, *Dalmania*, *Orthis bifurcata*, *Strophomena rugosa*, *Leptaena sericea*, *Rhynchonella neglecta*, *Encrinites* and fragments of encrinite stems, many of which are encased in calc spar."

Professor Borden failed to recognize that the part of the paragraph which he quoted applies only to rocks overlying his supposed Clinton, and that the Lower Niagara fossils there enumerated occur over 12 feet above his supposed Clinton. On page 160, he adds several statements which he had secured from Dr. Cornett's paper to his own account of the Clinton formation, intermingling the two. This is

shown by the fact that the so-called Clinton rocks of Professor Borden, my Madison bed rocks, are never salmon or pink in color and there are no thin layers in it which can be used for flagging. The flagging stones here referred to belong to my Osgood and Lower Laurel beds of the Niagara formation.

Mr. S. A. Miller knew comparatively little of the Middle Silurian rocks of Indiana from personal experience. Most of the fossils from this part of the Indiana geological section he bought. He was richly supplied by collectors with fossils from Madison, the Big Creek region, and Osgood. The fossils identified by Dr. Cornett and quoted by Professor Borden as Clinton were easily recognized by Mr. S. A. Miller as of Niagara age. Hence, Mr. Miller denied absolutely the existence of any Clinton in Indiana.

Curiously enough, there is a little Clinton in the section at Madison. Between the uppermost sandy limestones (Madison bed), belonging to the Lower Silurian (Professor Borden's Clinton), and the main body of beds called Clinton by Dr. Cornett (my Osgood beds), there is a 12 to 18 inch bed of siliceous pink or salmon colored limestone, which is the sole representative here of the much thicker sections of Clinton found northeastward in Indiana and Ohio. At Madison, it is nearly unfossiliferous. Its age was therefore not recognizable in any hurried survey, and while this layer is actually included by Dr. Cornett in his Clinton, forming its base, this is not due to the fact that Dr. Cornett recognized its age, but rather to the fact that Dr. Cornett followed the custom of his predecessors in terminating the Lower Silurian section with the uppermost layer actually containing Lower Silurian fossils. This left the pink and salmon colored rock at the base of his next formation, his Clinton, which included chiefly the Lower Niagara (Osgood) beds.

In the report on Jennings County, in the Seventh Report of the Indiana Survey, 1876 (page 151), Professor Borden continues to refer to the sandy Madison beds of Clark County as Clinton, because in Fourteen Mile Creek the upper part of the blue fossiliferous Lower Silurian limestones and the overlying sandy unfossiliferous Madison beds are the only beds distinctly tilted, with the upper edges of the inclined strata distinctly cut away. Whether there is actually an unconformity here between the Lower and Upper Silurian is a different matter. The real Clinton on Fourteen Mile Creek is not so exposed as to attract attention in connection with the upturning of the strata to which allusion is made, and probably would not have been recognized by Professor Borden, even if found.

On page 183, Professor Borden quotes a letter from Dr. Cornett, in which the latter makes clear the fact that the line between the Upper and Lower Silurian is between the banded limestone of Owen's report (the Clinton of Professor Borden, my Madison beds) and the overlying beds (my Osgood beds). This he does by insisting once again that Lower Silurian fossils were found 49 feet above the *Favistella* bed, overlying 32 feet of the non-fossiliferous banded limestone of Owen.

The white Niagara limestone at the crossing of a branch of Cedar Creek, on the old Versailles and Osgood pike, now an old dirt road, must be some Lower Silurian layer, since no Upper Silurian rock is exposed there.

The fact that Professor Borden, in spite of Dr. Cornett's correction, did not yet understand what Dr. Cornett meant by the Clinton is shown on page 151, where he states that in some localities the Clinton, upon weathering, leaves behind considerable beds of *sand*, and the fact that on page 154 he refers six feet in the section southeast of Butlerville to the Clinton, because these strata (Madison-like beds at the base of the Osgood beds) resemble the sandy limestone beds (Madison beds) of the bluffs along the Ohio River, in the counties with which he was familiar. They belong, however, to a higher horizon.

The first geologist connected with the survey who had a clear understanding of Dr. Cornett's views, and the change of name which this made necessary for the sandy limestones and shales (Madison) at the top of the Lower Silurian, was Mr. E. T. Cox, the State Geologist (Eighth, Ninth and Tenth Reports of Indiana Survey, 1878, pages 18-20). He mentions the fact that Dr. D. D. Owen called them the "Banded Rock," and gives even more convincing lists of fossils from the layers at the top of the Banded Rock: *Orthis biforata*, var. *acutilirata*; *Orthis retrorsa*, *Orthis subquadrata*, *Orthis insculpta*; *Strophomena planumbona*, *Strophomena sulcata*, *Streptelasma corniculatum*, *Rhynchonella capax*, *Rhynchonella dentata*, *Zygospira headi*, *Ambonychia radiata*. The Banded Rock is clearly referred to the Lower Silurian. The overlying 23 feet, almost entirely composed of Osgood beds, Mr. Cox does not consider as Clinton, seeing no good ground for separating them from the Niagara. In this he differs from Professor Borden, and correctly so, the Osgood beds being only the basal beds of the Niagara. He fails to recognize the 22 inches of pink and salmon colored rock at the base of this Lower Niagara at Madison as Clinton, as was natural, the pink and salmon colored Clinton near Madison being nearly devoid of fossils. And who would expect to find a whole formation represented by 22 inches of rock, as is the case here?

In the report on Wayne County in the same (Eighth, Ninth and Tenth) report, he refers to the Niagara, the 22 to 25 feet of rock at Elkhorn Creek Falls, which had been variously referred to the Clinton and Niagara. As a matter of fact, the lower 14½ feet of this section are formed by real Clinton; overlying this are three or four feet of Dayton limestone, the lowest member of the Niagara; any higher rock which may be exposed must also be Niagara. There is no representative of the Madison bed here.

In the report on Fayette County, in the Fourteenth Report of the Indiana Survey, 1884, page 51, Dr. M. N. Elrod refers to the Clinton Group 20 feet of stone which probably include the seven feet of hard Lower Silurian limestone which terminates the Lower Silurian at Ball's quarry, and the six feet of brownish limestone overlying the Clinton, which replaces the lower Osgood of more southern localities.

In the Fifteenth Report of the Indiana Survey, 1886, pages 11 and 16, Maurice Thompson quotes Professor Borden's incorrect reference of the gray and yellow stratified sandstone (Madison bed) to the Clinton, and also Dr. Elrod's too extended Clinton section just discussed.

In Notes on the Clinton Group Fossils, with special reference to collections from Indiana, Tennessee and Georgia, Proceedings Boston Society of Natural History, Vol. 24, 1889, page 264, is recorded a section of the rocks at Hanover, Indiana. In this section the real Clinton, 12 to 20 inches thick, is called the fossiliferous Clinton. The so-called cherty bed, two to three feet thick, with *stromatoporoids*, is the top of the Lower Silurian, the stromatoporoids being *Labechia*. The 20 feet of drab, non-fossiliferous limestones, believed to be Clinton, are the Madison beds. The eight to ten inches of blue shale with fossils, thought to belong to the Medina, contain typical Cincinnati Group fossils, but overlie the *Favistella* bed, which in turn is at the top of the blue fossiliferous calcareous rocks which are commonly found below the Madison beds.

These notes were furnished by Prof. A. H. Young. In these notes the Clinton of Indiana was for the first time identified by means of fossils. The significance of Dr. Cornett's discoveries as a proof of the Lower Silurian age of the Madison beds was not recognized by Dr. Young, and I was ignorant of both the geology and the literature of the Hanover-Madison region.

At about this time, 1889, Mr. George Hubbard discovered a layer of dense bluish limestone with *Pleurotomaria* and other fossils above the fossil layers at the top of the sandy (Madison) limestones (Proc. Indiana Acad. Sci. 1891). He recognized their Lower Silurian origin.

and he, together with other collectors, furnished a number of new species from this formation to Mr. S. A. Miller. This bed I have named the *Murchisonia hammelli* bed in my report, owing to the frequency of this characteristic fossil. It confirms still further the Lower Silurian Age of the Madison beds.

In the Twenty-first Annual Report of the Indiana Survey (1897) the writer for the first time employed the name Madison beds to designate the massive sandy limestones at the top of the Lower Silurian. The writer attempted to distinguish clearly between the Upper and Lower Silurian formations, and to firmly establish Dr. Cornett's views as to the position of the Banded Rock or sandy limestones at the top of the Lower Silurian. All the typical developments of this formation in Indiana are described. They occur in the neighborhood of the Ohio River.

In the Twenty-second Report (1898), some of the equivalent strata in Franklin County and elsewhere are discussed, but their lithological resemblance to the Madison beds of the river counties is only remote.

A.—MADISON BEDS—CUMBERLAND SANDSTONE.

III.—KENTUCKY.

A.—CUMBERLAND SANDSTONE.

In Kentucky the Madison beds are typically developed in the counties along the Ohio River, opposite Indiana. On going southward into Nelson, Marion and Lincoln counties, the Madison beds vary from the type, losing, for instance, the tendency towards brown and purple banding so often shown in the river counties. They remain, however, nearly barren of fossils. The *Murchisonia hammelli* bed is typically developed in Oldham County. Abundant Lower Silurian fossils are not infrequent, in places, above the Madison beds in Marion and Lincoln counties. But in general the Madison beds beneath are devoid of fossils, and the fact that the Lower Silurian fossils may be found overlying the Madison beds seems to have escaped attention. Professor Shaler studied the Madison beds in the southern part of Kentucky, along the Cumberland River, and he gave to them the name Cumberland sandstone. No section is described and no very precise locality is mentioned with the exception of Burksville, on the Cumberland. It is not possible to determine just where he began his Cumberland sandstone section, and at what level he concluded his section. It is therefore impossible to determine just what was included in his section. This is a matter of some importance, since in

some regions the Cumberland sandstone, or rather its equivalent, is overlain by the Clinton, and this Clinton was never recognized west of the Cincinnati anticlinal. The result has been that in the various Linney reports the name Cumberland sandstone has been oftener employed incorrectly than correctly.

Considerable pains have therefore been taken in the following lines to collate every allusion to the Cumberland sandstone which appears in Vol. III, New Series of the Kentucky Survey, the volume in which the Cumberland sandstone is best described, and to arrange them in such a fashion as to make the chief characteristics of these sandstones as clear as possible. The name will be found very useful in the description of rocks from the southern parts of Kentucky, and may, in the estimation of others, deserve a wider application.

The upper limit of the Lower Silurian of Kentucky was placed by Dr. D. D. Owen just above the *Favistella stellata* bed, or whatever other well recognized fossils closed the record of life in the blue Lower Silurian limestones. The unfossiliferous sandy limestones and clays just above (Madison beds) were referred by him to the Upper Silurian (Kentucky Survey, Vol. 2, Old Series, 1857). With this opinion Professor N. S. Shaler agreed, considering, in 1873, 1874, 1875, the sandy limestones equivalent to the Oneida and Medina formations, which form the base of the Upper Silurian in New York.

In 1877, three years after the discoveries of Dr. W. S. T. Cornett, proving that these sandy limestones (Madison beds) were Lower Silurian, Professor Shaler refers to them under the name Cumberland sandstone as the upper member of the Cincinnati Group.

Professor Shaler added little to our knowledge of the Madison formation beyond the name, *Cumberland sandstone*, given owing to the abundant occurrence of these sandy limestones on the upper waters of the Cumberland in southern Kentucky. Dr. Owen's name, "Banded limestone," very pertinent in southern Indiana, was discarded for Kentucky.

The Cumberland sandstone received its name from a part of the upper Cumberland River, in southern Kentucky. The sandstone occurs on both sides of the river, extending in a narrow area, about 50 miles long, from the southwestern border of Pulaski County, to the southern edge of Kentucky. The typical exposures are located above Burksville, in Cumberland County. Southward, the sandstone may be traced beyond the limits of the State, into Tennessee. Northward, for a distance of about 25 miles, the sandstone is hidden by the overlying formations, but comes to light again along the Green River, in Casey County, and at numerous exposures in Marion, Boyle, and

Lincoln counties. Thence, the sandstone extends northwestward and northeastward, around the borders of the famous blue grass area of north central Kentucky, an area characterized by the richly fossiliferous limestones of the Cincinnati Group. The more typical exposures of the Cumberland sandstone are, therefore, limited to the southern crest of the Cincinnati axis, and to its more northern flanks. (Pages 142, 159, 169, foot note, 387, 394.)

The Cumberland sandstone had not been fully studied at the time of writing the third volume of the Kentucky Survey, and estimates of its thickness vary considerably. It is stated to range from five to fifty feet in thickness, and to be sometimes 100 feet thick, although usually it does not exceed 30 feet. The sandstone is said to thicken considerably on going southward from the Ohio River towards the southern exposures. This is considered tolerably clear proof that the fine-grained sand of which the Cumberland sandstone is composed was derived from some source of supply situated south of Kentucky. This source, it is likely, was an extension of the high land which now forms the northeastern corner of Alabama and the northwestern part of Georgia. This southern area which furnished the sand is probably to be considered a southwestern prolongation of Professor Shaler's Unaka Island. (Pages 142, 160, 163, 170, 192, 387, 394, 409.)

The Cumberland sandstone is rather fine-grained. It commonly has a greenish color. This color is especially characteristic of the southern exposures along the Cumberland River, and is possibly due to phosphate of iron. It is stated to be entirely barren of organic remains, the absence of evidence of life being far more conspicuous in the case of the Cumberland sandstone than in the case of the lower sandstones of Lower Silurian Age exposed within the area of the Cincinnati anticlinal. (Pages 142, 159, 160, 387, 394.)

Owing to the failure to find fossils, Professor Shaler was not able to identify the horizon of the Cumberland sandstone. In the Notes on Investigations of the Survey, during the years 1873, 1874 and 1875, he states that the sandstone totally interrupts the Cincinnati series, so that it can not be called a member of that group, but must be considered the equivalent of the Oneida conglomerate and the Medina sandstone of New York; passage of the fossiliferous Cincinnati Group rocks into the Cumberland sandstone very frequently accomplishing the change. In the report for the year 1877, in the same volume, he states that it forms the upper member of the Cincinnati Group. (Pages 141, 144, 153, 155, 159, 160, 163, 387, 394.)

The statement that the Cumberland sandstone forms the upper member of the Cincinnati Group does not necessarily indicate that

Professor Shaler considered them of Lower Silurian Age. An examination of the literature of the Cincinnati Group suggests that the Cincinnati Group was by many geologists considered a geological complex, whose upper limits were formed by the basal members of the Clinton Group. Even those who believed that the clays and sandy limestones at the top of the Lower Silurian are of Medina Age at times referred to them as members of the Cincinnati Group. A striking example of this form of interpretation is given in Volume I of the Ohio Survey, page 414.

b.—KENTUCKY, WEST OF THE CINCINNATI ANTICLINE.

In the report on Washington County (Kentucky Survey, Nov., 1882, page 18), Mr. W. M. Linney gives the name Cumberland sandstone erroneously to the sandy beds below the *Favistella stellata* and *Columnaria* bed, instead of giving it to the sandy layers above the coral beds, to which it more properly belongs. In his section along the road up the hill, east of Wheatley's Branch, the sandy shales and sandstones and the heavy limestone are Lower Silurian, overlying sandy shales, which in their turn overlie the coral bed. The soft sandstone is the real Clinton. The shales at the top are the Osgood clays of Indiana, and Linney's Crab Orchard shales. (See Linney's later reports.) They are more shaly at the base, and their real thickness is at least 16 feet.

Notwithstanding the fact that Dr. W. S. T. Cornett had identified the sandy limestones (Madison beds) as Lower Silurian already in 1874, and that Professor Shaler in 1877 had referred to them, without proof, as the upper member of the Cincinnati Group, W. M. Linney in his report on Washington County, as well as in his report on Lincoln County (Kentucky Survey, Report on Lincoln County, 1882, pages 14-16), continues to consider them as Medina. He fails to distinguish the Clinton from the underlying Lower Silurian (Madison) sandy limestones, and includes them with the latter in his *Medina*. At James's Mill (page 15), only Clinton is exposed. The occurrence of *Atrypa reticularis* (page 16) is doubtful, even in the Clinton, this fossil never having been found by me in the Clinton limestone anywhere near the Cincinnati anticlinal.

In the report on Nelson County (Kentucky Survey, W. M. Linney, January, 1884), Mr. Linney states: "On Scrub Grass Creek, in Boyle County, some years since, I found resting upon the top of the Hudson River beds a conglomerate two inches thick, with the characters as given the Oneida conglomerate in New York. It is the only point at which I have been able to find it * * " (page 37). Considering the

fact that along Scrub Grass Creek the Devonian black slate rests directly upon the Lower Silurian, and that there is no conglomerate at this horizon, it is difficult to determine what Mr. Linney really found. Mr. Linney continues to refer both the sandy limestones at the top of the Lower Silurian and the overlying Clinton limestones to his Medina. (Pages 37, 38.)

In the report on Marion County (Kentucky Survey, January, 1885), Dr. W. T. Knott follows Mr. Linney in referring the sandy limestones (Madison) above the coral beds to the Medina, instead of to the Lower Silurian. This is shown, among other things, by the geological map accompanying the report, where the sandy limestone is mapped with the yellow color used to indicate Upper Silurian and Devonian rocks. This fact is readily established, owing to the entire absence of the Upper Silurian and Devonian over a large part of the area thus mapped.

In trying to identify the strata near the Nelson-Marion county line, Dr. Knott made a curious mistake. In general he followed the lead of D. D. Owen, Linney and other geologists in making the coral bed the top of the Lower Silurian and classing the immediately overlying rocks as Medina, the still higher clays being considered as of Clinton Age.

However, near the Nelson-Marion county line there are two coral beds; the lower one contains *Favistella*, *Columnaria*, and *Columnopora*; the upper one contains *Tetradium* as the more characteristic fossil. Believing the *Tetradium* layer to be identical with the coral layer which is found lower down, he gives the name Medina to the rocks overlying the *Tetradium* as well as to the layers overlying the coral bed. But the rock overlying the coral bed is the Madison bed, and the rock overlying the *Tetradium* bed at Coon Hollow, New Hope and near the county line is of Clinton Age. By accident, therefore, some of the Clinton has been correctly named.

The Medina to which Mr. Linney refers in his reports on Henry (page 12), Shelby (page 11), and Oldham (pages 10, 11) counties (Kentucky Survey, 1887) is also the Madison bed at the top of the Lower Silurian.

C.—KENTUCKY, EAST OF THE CINCINNATI ANTICLINE.

In the report on Garrard County (Kentucky Survey, Linney, 1882), it is very evident that Linney failed to see that Professor Shaler's Cumberland sandstone and his own typical Medina are the same rocks, both being Lower Silurian. (Pages 18, 19, 20.) The rock at the top

of Linney's supposed Medina, which weathers red on exposure, is in reality part of the Clinton (page 20).

In the report on Clark County (Kentucky Survey, 1884), Linney again attempts to distinguish between a lower set of sandy rocks, to which he erroneously confines the term Cumberland sandstone (page 24), and an upper set of sandy layers, which he calls Medina (page 26). The *Favistella* bed being absent, he evidently was at a loss where to place the dividing line between the Cumberland sandstone and the Medina, but tried to uphold preconceived notions. The same attempt to divide the sandy beds above the blue, fossiliferous Cincinnati Group limestones into a lower Cumberland sandstone (page 56) and an upper Medina series (page 59) is shown in the report on Montgomery County (Kentucky Survey, Linney, 1884).

In the report on Mason County (Kentucky Survey, 1885), Mr. Linney refers the same Lower Silurian sandy beds to the Medina (page 14). This is also done in the report on Bath County (Kentucky Survey, 1886, pages 16, 17) and in Marion County (Kentucky Survey, 1886, page 68).

In the Richmond folio, United States Geological Survey (1898), Marius R. Campbell adopts the name Richmond shale for the Upper Hudson beds of the Linney reports. This name was suggested by Mr. E. O. Ulrich for corresponding beds in Indiana. The Cumberland sandstone is not distinguished from the richly fossiliferous portion of the Richmond shale. I can scarcely agree with the statement that the calcareous sandstone at the top of the Richmond shales, the representative of the Cumberland sandstone, can with difficulty be distinguished from the formation above.

It would be more true to state that it would be often difficult to determine where the dividing line should be drawn between these calcareous shales and the fossiliferous limestones and clays which form the more typical Richmond beds.

d.—SOUTHERN KENTUCKY.

Professor Shaler's views on the age of the Cumberland sandstone (Oneida, Medina, 1873-1875; top of Lower Silurian, 1877) are given earlier in this paper.

In Volume I, Ohio Survey, Professor Newberry refers the Cumberland sandstone (50 feet of limestone and shales) in his Burksville section to the Niagara.

In the report on Clinton County (Kentucky Survey, 1890), Dr. R. H. Loughridge refers the Cumberland sandstone to the Medina. (Pages 9-11.)

Prof. Edward Orton, in his report on Petroleum, Natural Gas and Asphalt Rock (Kentucky Survey, 1891), alludes to Upper Silurian limestone in the neighborhood of Burksville. This can refer only to the Cumberland sandstone.

In the Geological Survey of Minnesota, Volume III, Part II, 1892-1896 (1897), page ciii, Prof. N. H. Winchell and Mr. E. O. Ulrich place the Cumberland sandstone at the top of the Cincinnati Group, more specifically at the top of the Richmond Group. That part of the section exposed in Marion County which contains abundant masses of *Columnaria*, *Tetradium*, *Labechia*, and rarer specimens of *Beatricea*, belongs just beneath the Cumberland sandstone or Madison bed, as identified by the present writer. In some localities there is a recurrence of *Tetradium* and *Labechia* in a thin layer at the summit of the Madison bed, but this is not the coral bed of the Kentucky surveys.

On page 103, Mark Linney is quoted as correlating the Cumberland sandstone with the Oswego sandstone, and it is suggested that "Linney was probably correct."

A.—MADISON BEDS—MOTTLED CLAYS.

IV.—OHIO.

In Ohio the Madison beds are replaced by clays and clayey shales which are at times mottled with purple and reddish purple and are usually devoid of recognizable fossils. Near the crest of the anticlinal, from the Miami River westward toward the Indiana State line, the clays are less often mottled, are more calcareous, and contain more fossils. In the more western localities Lower Silurian fossils occur even in the highest layers of the clay series, and their Lower Silurian Age is unquestioned. The exposures on Morris Hill tell a similar story for the mottled clays on the eastern side of the anticlinal, notwithstanding the fact that the more eastern exposures of these clays have so far not yielded identifiable fossils. The following notes will indicate the position assigned to these clays by various members of the Ohio Geological Survey.

In Ohio, after a lapse of many years, geological investigations were resumed under the auspices of the State in 1869. In the first Report of Progress of the Ohio Survey for 1869, published in 1871, page 54, Prof. J. S. Newberry does not include the Medina in his chart of the geological formations of the State. In the report on Montgomery County, however, Prof. E. Orton, in describing the Lower Silurian rock, says:

"The uppermost layers of the series from 6 to 20 feet generally deviate in mineral character from the beds already described, in that they consist, for the most part, of red and yellow clays, though occasionally of a yellowish, arenaceous limestone, which is sometimes turned to account as a firestone or as a building rock. It is probable that this portion of the series will be hereafter identified as the representative of a distinct group of rocks, viz., the Medina sandstone of the New York Survey." (Pages 147, 148 and 164.)

In his reports on Highland County and the Cliff limestones of Highland and Adams counties, in the Report of Progress for 1870, published 1871, Professor Orton speaks of these shales, clays and shaly limestones at the top of the Lower Silurian with much more confidence, again calling them Medina. (Pages 257, 267, 268, 277, 295.)

In Volume I of the Geological Survey of Ohio, 1873, Professor Newberry states that the Medina "has been struck in borings for oil in northern Ohio, but does not show itself by any well marked outcrop within the State." (Page 61.) On page 101, these well borings are stated to have been made at Toledo, Waterville and Vermillion; and on page 127 at Columbus. On page 103 a tendency is shown to refer the red, blue and mottled calcareous shales at the top of the Lower Silurian, so far not known to have fossils, to the Medina. I do not know where, in the vicinity of Dayton (page 126), clay or shales occur at the top of the Lower Silurian which do not contain easily recognizable Lower Silurian fossils. Indeed, my experience has been that while it is extremely difficult to find fossils in these clays and shales at many points along the eastern outcrops of the Cincinnati anticlinal, fossils become rather frequent at this horizon along the crest of the arch and westward. The strata at Madison, Indiana (page 127), which Professor Hall, in the notes on his journey of 1841, referred to the Clinton, belong to the top of the Lower Silurian (Madison beds). On page 414, the red shales of the Ohio end of the Cincinnati anticlinal are considered by Professor Orton to be Medina. On page 462, Professor Orton refers the often red, non-fossiliferous shales or marlites of Clarke County to the Lower Silurian, indicating that he was not always successful in persuading himself that these shales were Medina.

In Volume II of the Ohio Survey, 1874, in the report on Greene County, page 663, the light blue or red colored unfossiliferous shales are again tentatively placed by Prof. Edward Orton in the Medina.

In Volume III of the Ohio Survey, 1878, Professor Newberry refers both the red, mechanical sediments struck in well borings in northern Ohio and the calcareous colored clays outcropping in southwestern

Ohio to the Medina. By this time it had become known that the Banded Rock of Indiana was not Clinton, but Lower Silurian (discovered by Dr. W. S. T. Cornett, in 1874), but it was not recognized that the age of the Banded Rocks of Indiana was identical with that of the colored clays at the top of the Lower Silurian in Ohio (pages 4 and 6).

On page 384, in the report on Warren County, Professor Orton expresses the view, held certainly as early as 1857 (Vol. II, Old Series, Kentucky Survey, D. D. Owen, pages 102, 103), that the coral bed marked the junction between the Upper and Lower Silurian when other well recognizable Lower Silurian fossils (usually brachiopods) were not at hand; under the term "corals" are included true corals and stromatoporoid sponges. The overlying clays completing the series to the Clinton limestone (page 384, line 8) are evidently considered as Upper Silurian. According to my own notes, the Clinton at Morris Hill lies 14 feet above the *Tetradium* and *Stromatopora* bed of Orton. Four feet of clay, mottled with green and purple, lie two feet above this bed; that mottled clays can belong to the Lower Silurian is shown by two feet of limestone, with *Orthis occidentalis* six feet above the coral bed and two feet of thin limestone layers, with bryozoans of Lower Silurian age, eight feet above the coral bed, leaving only four feet of shaly rock not accounted for. Morris Hill is nearly straight south of Dayton, and lies along the line at which the clays at the top of the Lower Silurian, the supposed Medina clays of Orton, become fossiliferous on going westward. This is the reason why no Medina is identified in Preble County (pages 404-419), which lies still farther west.

The five feet of sandy limestone alternating with thin beds of clay, which occur at the base of the Clinton in Clinton County along Todd's Fork (pages 442, 443), I have called the Belfast bed. Their position will be referred to later.

In the report on Miami County, page 481, Professor Orton's section, in order to correspond with his belief that red shales are Medina, should read (not correcting his measurements):

Clinton, 35 feet.

White, fine grained sandy layer, 6 inches; associated with the Clinton.

Medina light blue clay, 5 feet.	} Strata dividing rocks known to be Upper Silurian from those known to be Lower Silurian.
Medina red shales, 4 feet.	

Blue shale, known to belong to the Cincinnati Group, 20 feet.

When I visited this locality I found a section very different from the one just quoted beneath the Clinton at this locality; so very different,

in fact, that it is impossible for me to determine what are the elements of Professor Orton's section.

At the railroad cut north of Tippecanoe (page 481), annelid teeth, such as are found in the Lower Silurian, occur within seven feet of the Clinton, but the first easily recognized Lower Silurian fossil, *Orthis occidentalis*, occurs 21 feet beneath the Clinton. At the bridge a short distance below the falls at West Milton (page 481), however, according to my notes, *Orthis occidentalis* occurs nine feet below the Clinton, the upper five feet corresponding to the Belfast bed to be described later.

In Volume VI of the Ohio Survey, 1888, Professor Orton (pages 4, 11) again refers the red and otherwise colored shales at the top of the Lower Silurian to the Medina. Small pebbles are said to occur in some of the sandstone beds, included in the Medina. Where? The Medina is identified in the wells at Findlay (page 115).

In Volume VII of the Ohio Survey, 1893, the statements of Volume VI are repeated (page 11).

In Notes on a Geological Section at Todd's Fork, Ohio (Clinton County), published in the American Geologist, pages 412 to 419, I referred the five feet of sandy rock below the Clinton to the Medina, and described the fossil annelid teeth which this layer contains. The layers were in a later publication referred to the Belfast bed. Two feet of sandy limestone at Fair Haven were erroneously considered Medina, owing to the presence of a large unfamiliar aviculoid shell.

In my paper "On Clinton Conglomerates and Wave Marks in Ohio and Kentucky," Journal of Geology, Vol. III, '95, the sandy limestones at the top of the Lower Silurian in Kentucky are erroneously referred to the Oneida and Medina (page 13), and the Crab Orchard shales of Kentucky are erroneously referred to the Clinton (page 14).

There is no chert in the Clinton of Henry or Marion counties (page 15). There is no Clinton conglomerate near Fredericktown in western Washington County (page 15). In fact, all of the references to Kentucky strata (pages 31-40) must be revised in accordance with my later discoveries. In these earlier statements, I merely followed the Kentucky Survey reports, and the corrections suggested by later personal observations have already been made on the preceding pages of the present paper.

A.—V.—BELFAST BED.

OHIO.

On the eastern side of the Cincinnati anticlinal, as exposed in Ohio from Clarke to Highland counties, there is a series of rather sandy, massive limestones, which occur between unequivocal Lower and Upper Silurian rocks: between the mottled unfossiliferous clays and the crinoidal Clinton limestones. They have been called by me the Belfast bed.

In his report on the geology of Highland County, Second Report of Progress, 1871, pages 268, 277, Prof. E. Orton expresses the belief that the massive sandy limestones used for bridge abutments near Belfast (Belfast bed) supply the place of the red shales (Prof. Orton's Medina), when the latter are wanting.

In the report on Greene County, Ohio Survey, Vol. II, '74, pages 663, 665, Prof. E. Orton evidently includes the sandy limestones (Belfast bed) in his Clinton, near Mr. Goe's residence, and elsewhere.

A similar disposition of these sandy limestone beds (Madison) was made by Prof. Orton in the report on Warren County, Ohio Survey, Vol. III, '78, pages 384, 385, and by Mr. John Hussey, in the case of the corresponding beds in Clinton County, page 442.

The more clayey representatives of the Belfast bed in Miami County (page 481), and at other western exposures, were naturally classed with the clayey Medina of Orton.

In my paper "On Clinton Conglomerates and Wave Marks in Ohio and Kentucky," 1895, the five feet of sandy limestone with annelid teeth at Todd's Fork, later called the Belfast bed, are here still called Medina (page 18). The four feet of similar stone (Belfast bed) near Sharpsville with an unknown *Orthis* (page 21), and the four feet of similar rocks (Belfast bed) in the various sections near the type locality, Belfast, with annelid teeth and *Halysites* (pages 24-26), are all referred to the Medina.

In my paper giving "An Account of the Middle Silurian Rocks of Ohio and Indiana," Journal Cincinnati Society of Natural History, Vol. XVIII, '96, I give a full discussion of what was, at that time, known of the rocks at the top of the Lower Silurian. The heading at the top of page 163, "The Belfast Bed of Ohio. Formerly Called Medina, With Frequent Observations on the Clinton of Ohio," is misleading. The four to five feet of sandy limestones which I here, for the first time, call the Belfast bed, are not the typical Medina rocks of Prof. Orton and other writers on Ohio geology, and are therefore not the rocks formerly called Medina in Ohio. It should be remembered

that the identification of the Medina in Ohio has not only been solely lithological, but has been practically made upon the sole basis of color. Had the clays near the top of the Lower Silurian not had a single touch of red, or purple color, it is probable that the name Medina would never have been applied to them. Prof. Orton's typical Medina, consists not of the four to five-foot sandy limestone bed I called the Belfast, but of the much thicker underlying clays.

The sandy limestone beds could not be definitely assigned even in Prof. Orton's section. They lie between Prof. Orton's unequivocal Clinton and his reported Medina. I am not certain as to the age of the Belfast bed myself. The presence in it of *Halysites catenulatus* seems to determine its Upper Silurian age, and annelid teeth are hardly good means of identifying horizons in the present state of our knowledge of these forms. I do not see in what way we gain by insisting that the Belfast bed is of Medina age, before we have positive reasons for making this identification. The red, purple, and otherwise colored clays below the Belfast bed and its equivalent, are, however, Lower Silurian, as is shown by the presence in them of Lower Silurian fossils. A good section illustrating this, is seen at Morris Hill (pages 173, 174), already commented upon.

The Belfast bed, whatever its age, is well exposed along the whole eastern outcrop of the Middle Silurian. It is seen in the most western outcrops on the eastern side of the summit of the Cincinnati anticlinal, being exposed near Dodds, Lytle, Centerville, Soldiers' Home, near Dayton, and at Ludlow Falls. It loses its sandy character and becomes a layer of hardened calcareous clay in its more western exposures, from Lytle to Centerville and Ludlow Falls. In Preble County it is entirely absent, and nothing corresponding to it has been discovered in Indiana. The Belfast bed is the only bed which I have seen in Indiana, Ohio or Kentucky whose position at present is doubtful. It is the only bed which may be Lower Silurian and which may be of Medina age. As far as known at present, it is confined to the eastern side of the Ohio end of the Cincinnati anticlinal.

B.—CLINTON.

I.—INDIANA.

The second Geological Survey of Indiana began its labors in 1869. The first Middle Silurian rocks studied occur in the counties along the Ohio River. This is not a favorable location for the recognition of the Clinton formation. The Clinton in the river counties of Indiana

rarely exceeds four feet in thickness, and often thins down to about one foot. In the more southwestern exposures it is often a siliceous limestone, almost devoid of fossils, and lithologically similar to the more immediately adjacent rocks. In the more northeastern exposures, where it has a salmon brown color, and contains fossils, the fossils are so firmly imbedded in the rock that their collection is of no interest to collectors, and their study is likely to be neglected. The Clinton was therefore never identified as a separate formation in this part of Indiana until 1889, when Prof. A. H. Young recognized the Clinton character of the fossils in the salmon colored limestone layer near Hanover, and sent to me a fair collection of these fossils.

In the meantime the thin band of Clinton was classed by different writers either with the Madison bed below, or the Osgood bed above. As far as can be determined, Prof. Borden, in the early reports, included the Clinton, with the overlying beds, in the Lower Niagara, but called the underlying Lower Silurian beds (Madison beds), *Clinton*. Mr. E. T. Cox also includes the real Clinton in the Lower Niagara, but he calls the underlying rocks, *Lower Silurian*, which is correct (Eighth, Ninth, and Tenth Reports, '79).

In his report on Jennings County (Seventh Report, 1876, page 154), Prof. Borden incorrectly refers the Madison-like beds, at the base of the Osgood beds, north of Madison (in Jefferson County), to the Clinton, on account of their lithological resemblance to the sandy limestones which occur at the top of the Lower Silurian (Madison beds), *his Clinton*. Prof. Borden's error is easily explained. The resemblance of the lower Osgood rocks in some parts of Jennings County to the Madison bed exposures at various points along the Ohio River is so great, that, in my account of the strata in Jennings County, I refer to them as the *Madison-like* Osgood beds.

Dr. M. N. Elrod (in the Twelfth Report of the Indiana Survey, Decatur County, 1883) was the first person to recognize clearly that there were two shales in the Niagara; one near the top, *Waldron* shale, and one at the base, which he called the Lower Niagara shale (Osgood shale). While it is evident that Dr. Elrod knew that the Lower Niagara shale was not a homogeneous mass, but consisted of a thin upper shale, a thin intermediate set of flag limestones, and a thick bed of marls at the base, he did not succeed in identifying all three parts of the Lower Niagara shale in all of his sections. He seems to have been of the opinion that the Lower Niagara shale varied considerably in thickness, so that in some places it was represented by only one or two feet of shale.

Dr. Elrod did not succeed in recognizing the Clinton either lithologically or paleontologically. He called anything Clinton which lay between the base of what he considered the Lower Niagara shale and the top of what he considered as Lower Silurian, without reference to the lithological or paleontological characteristics of whatever at any locality he identified as Clinton. The result is that he identified both real Clinton and also rocks belonging below the upper shale of his Lower Niagara shale as *Clinton*. Owing to the fact that some of these identifications are correct, Dr. Elrod is the first geologist who gave the name *Clinton* to rocks which are Clinton, occurring in Indiana, without including in the same section, at the same locality, rocks which are not Clinton.

Clinton and Lower Silurian rocks are the only rocks exposed at Parker's Mill. The identification, therefore, must be correct (page 130).

Clinton occurs in the creek bed, east of Hollensbe's quarry, and west of Roszburg. It occurs about eight feet below the Upper Osgood shale. Dr. Elrod gives a thickness of only two inches to the shaly clay which he identifies as Lower Niagara shale. It is very probable that he meant to give it a thickness of 20 inches, a cipher being omitted. The context shows that he was aware of the fact that this was only the upper part of his Lower Niagara shale section. Dr. Elrod's suggestion that the remainder of the Lower Niagara shale section (including the Osgood limestone and the Lower Osgood shale) is six feet thick is fairly correct. This makes it very probable that when he identifies the underlying rock as Clinton, that he had the Clinton in mind. It is difficult, however, to understand why he should call the salmon brown Clinton *buff*, and why he should refer to the Clinton as being found nearer Roszburg, when the Clinton is exposed very close to the first exposures of the Lower Niagara shale (pages 120, 121).

At Ducrow and Gleason's quarry, Sand Creek Township (page 123), Dr. Elrod again applies the name Lower Niagara shale to the one foot two inches of marly clay at the top of the Osgood section. The three feet of thin ledges of flagging include the Osgood limestone and the upper part of the Lower Osgood clay, which forms a sort of rubble limestone in this section of the State. The Clinton is said to be eight inches thick and to be a hard, buff stone. It must, therefore, be a part of the lower portion of the Lower Osgood clay, at times called by me the Madison-like Osgood rock. There is no real Clinton found at this quarry.

At the foot of the milldam, opposite the Boicourt quarry (page 126), Dr. Elrod once more applies the name Lower Niagara shale to a 12-inch bed of marl, which is the Upper Osgood clay. In this case, however, he makes no allowance for the lower part of the Lower Niagara shale section, but calls the 10-inch persistent layer, just beneath, which is the Osgood limestone, *Clinton*. There is no Clinton here.

Even if the six feet which Dr. Elrod found covered in the section taken on Squaw Creek had been exposed, he would not have been able to find real Clinton, this formation being absent (south of Millhousen, page 122).

At Larkin Walter's quarry (pages 118, 119), Dr. Elrod once more identifies the Upper Osgood shale, one foot eight inches thick, as Lower Niagara shale. Underlying this shaly marl he says there are beds of hard stone; these beds correspond in position to the Osgood section below the Upper Osgood shale. The Clinton is said to be a buff ledge about eight inches thick, occurring a few yards down the creek. The real Clinton is a salmon brown rock, about five or six feet thick, and is well exposed about 200 yards down the creek.

It may be noted in connection with all of the sections here discussed, that the word *buff* applies far better to the rocks at the base of the Osgood section than to the salmon brown Clinton of this county.

Shells identifiable with *Meristina intermedia* are far more common and more characteristic of the Osgood limestone than of the Clinton. The report does not state where the brachiopod was obtained, whether it occurred where Clinton was to be found.

In middle Fayette County, the Osgood beds, Dr. Elrod's Lower Niagara shales, are not very similar, lithologically, to the corresponding beds of Decatur County. The result is that all of the hard limestone beds underlying the undoubted Niagara are placed in the Clinton (Fourteenth Report of Indiana Survey, 1884, pages 47, 51). The result is that Dr. Elrod here includes rocks both above and below the real Clinton in his Clinton section, as already explained. (See above, the discussion on the Fourteenth Report.)

In the Fifteenth Report of the Indiana Survey, 1886, Maurice Thompson quotes Dr. Elrod's incorrect identification of the Clinton, just mentioned, for the second time.

The various references to the Clinton in Prof. E. P. Cubberley's paper on "Indiana's Structural Features, as Revealed by the Drill," in the Eighteenth Report of the Indiana Survey, 1893, pages 222 to 255, can scarcely receive serious attention when it is remembered how little success had up to that time attended the identification of this formation, where actually exposed, often with abundant fossils.

In 1896, I identified the Clinton at various points between Richmond and Osgood (An Account of the Middle Silurian Rocks of Ohio and Indiana, Jour. Cincinnati Soc. Nat. Hist., Feb., 1896), but interpreted the section at Ball's quarry incorrectly. This was the first attempt to trace the Clinton formation in Indiana by means of its fossils.

In the Twenty-first Annual Report of the Indiana Survey, 1897, I gave an account of the Clinton Group, tracing it from Charlestown Landing to the southern end of Decatur County.

In the Twenty-second Report of the Indiana Survey, 1898, I continued these studies of the Clinton, tracing it as far northward as middle Fayette County, correcting the interpretation of the section at Ball's quarry. In the last two reports, the Clinton was again identified at numerous localities, by its fossil contents.

B.—CLINTON.

II.—KENTUCKY. a, EASTERN COUNTIES.

The Clinton was identified in Kentucky as long ago as 1857, by Dr. D. D. Owen (Kentucky Survey, Vol. III, Old Series, 1857). A section taken in Lewis County, on the Ohio River below Vanceburg, near the mouth of Salt Lick Creek (page 120), contains strata doubtfully referred to the Clinton of New York. A section taken at Poplar Flats (page 125) includes flinty or cherty magnesian limestones, at base encrinital, referred to the Clinton. In Fleming County, at Mount Carmel, east of Poplar Plains (page 127), the Clinton is credited with the fossils *Glyptocrinus plumosus*, *Leptaena depressa*, and *Orthis circulus*. In Bath County, near Owingsville (page 130), ten or more feet of encrinital limestone are referred to the Clinton. Clinton is mentioned as occurring on Lulbegrud Creek, in Montgomery County (page 134), and in Estill County (page 137).

Dr. Owen did not identify the Clinton in the eastern counties of Kentucky by means of its fossils, although reference is made to these. *Glyptocrinus plumosus* was described by Hall from scattered fragments of crinoids which he believed to belong to the same species. These fragments consisted of parts of arms, parts of columns, and joints of columns. When Dr. Owen identified the Clinton in Kentucky, five years later, he must have identified the crinoid in question upon material of very questionable specific identity, to say the least. The *Leptaena depressa* is only a small *Leptaena rhomboidalis*; this

species actually occurs in the Clinton, but it ranges from the Cincinnati Group through the Clinton and Niagara, so that it can not be used very well to identify the Clinton. *Orthis circulus*, as far as I know, is not found anywhere in the Cincinnati anticlinal region. It seems to me almost certain that this must have been an incorrect determination. *Orthis flabella*, the form with rather numerous plications, i. e., with more plications than the more typical forms, is fairly common, and, together with *Leptaena rhomboidalis* and various joints of crinoid stems, is almost the only fossil commonly found, when fossils in general are scarce, in the Clinton of southeastern Kentucky. This may also be true in Fleming County.

The identification of the Clinton in Kentucky was chiefly based upon the presence of an iron ore bed at the summit of a series of limestones. A similar oölitic iron ore bed occurs at the top of the Clinton in New York. The identification of the Clinton was therefore lithological. In the eastern counties of Kentucky, where the iron ore bed is found, the Clinton is correctly identified. In southern Kentucky, where the iron ore bed is absent, the Clinton is more commonly referred to the Medina, and, in western Kentucky, to the Niagara, being placed in these formations together with other rocks.

Owing to the presence of the iron ore, Professor Shaler, also, called the oölitic iron ore bed and the limestones just beneath, Clinton. (Kentucky Survey, Volume III, New Series, pages 165, 166, 169.) It is evident, however, that a vague idea prevailed that the oölitic iron ore marked the upper limit of the Upper Silurian. The sentence at the bottom of page 163 (Kentucky Survey, Volume III, 1877) was evidently intended to read: "The most remarkable feature in the formation is the presence at various points of extensive deposits of iron ore at its upper limit."

And, on page 169, it is stated that "this so-called Clinton iron bed may not unusually be found at the top of the Silurian section." The diagrammatic section, on page 166, gives further direct expression to this belief. The name Silurian ore is therefore preferred to the name Clinton ore.

Professor Shaler's hesitancy to accept the term Clinton is the more noteworthy since, in 1877, when the third volume of the Kentucky Survey went to press, Prof. E. Orton had for six years considered the oölitic iron ore and the underlying limestones in the southern counties of Ohio as Clinton. Moreover, in 1873, F. B. Meek had identified certain fossils as belonging to the Clinton in Ohio (Volume I, Ohio Paleontology), and, in 1875, Professors Hall, Whitfield and Nicholson had referred fossils to the Clinton (Volume II, Ohio Paleontology).

There was no doubt that the Clinton of Ohio and Kentucky were identical. Aside from the presence of the oölitic iron ore bed at the summit of the Clinton in each State, the limestones beneath the iron ore bed, which were included in the Clinton, contained considerable chert in both States. These cherts were especially conspicuous, in both States, nearer the Ohio River. Moreover, in both States a great series of clays and clayey shales are found overlying the oölitic iron ore beds. And, finally, all the strata concerned could be easily traced from one State into the other.

In the various county reports of Kentucky, Mr. W. M. Linney follows Owen and Shaler in calling the oölitic iron ore bed and the underlying limestones *Clinton*. But it is difficult to determine without further study just what rocks, in addition to the real Clinton, were included by Linney in his Clinton. Before Mr. Linney took up the study of the more northeastern counties of the Cincinnati anticlinal region, he had become familiar with the great mass of clays and clayey shales in Lincoln and Garrard. The clayey shales are of Lower Niagara Age (Crab Orchard shales, Osgood bed), but were identified by Linney as Clinton. Accordingly, it was necessary for Linney to trace the clays of Lincoln and Garrard counties northward, and to show their stratigraphical identity with the oölitic iron ore and the Clinton limestones of more northern counties. The result is that he includes in his more northern sections of Clinton a number of clays at various horizons where it is not very likely that clays form a part of the Clinton section, excepting at the summit of this formation. It seems that in places he included even Lower Silurian clayey shales in his Clinton.

In the main, however, Linney's identifications of the Clinton, in Clark (1884), Montgomery (1884), Mason (1884), Bath (1886), and Fleming (1886) counties, are correct. Had Mr. Linney worked from the Ohio River counties southward, instead of in the reverse direction, it is very likely that he would have identified the Crab Orchard shales as Lower Niagara, and all the subsequent confusion resulting from this error would have been avoided.

In the Richmond folio, United States Geological Survey (1898), Marius R. Campbell does not distinguish the Clinton. The meagerness of fossil remains to be found in this and in the overlying formations is no doubt accountable for this. The failure to distinguish even the Silurian formations from the Devonian limestones is due to the difficulty of securing enough evidence to enable the geologist in the field to determine where to draw the line between them. The result is that the name Panola formation is suggested for the Upper

Silurian formations and the Devonian limestones. It is recognized that this is a complex. At the base of this complex is a series of coarse, rusty yellow sandy limestones, the greater part of which belongs to the Clinton. Near the top of these limestones large crinoid beads are very common. Immediately above, internal casts of *Whitfieldella cylindrica* are often fairly common. This fossil is characteristic of the Osgood beds in the Cincinnati anticlinal region. It does not occur in the Clinton, but in some localities is fairly common in the Osgood beds. The last two or three feet of the more continuous series of limestones are, therefore, to be classed with the Osgood beds. The immediately overlying clays belong to the Osgood beds, and form the characteristic element of this formation in the southern and eastern portion of the Silurian area in Kentucky. In the lower portion of these clays straggling layers of limestone are intercalated, so that the Osgood beds in this part of Kentucky open up with sandstone beds, followed by clay beds with intercalated sandy limestones, and these in turn are followed by a considerable mass of clays which form the bulk of the Osgood beds.

Near Whites, half a mile south of the station, along the railroad track, about 27 feet of the Panola formation are exposed. The upper three inches consist of a blue, argillaceous, gritty limestone, with fish teeth. It belongs to the Devonian formation. The lower 12 feet consist chiefly of limestone with shaly partings, belonging to the Clinton.

In the half a foot of rock above that assigned to the Clinton, large crinoid beads from the Clinton and specimens of *Whitfieldella cylindrica* are intermingled. This fossil is considered as the characteristic fossil of the Osgood beds. It is difficult to find traces of it in the railroad cut, although fragments are not infrequent in the dump north of the cut, where the stone removed from the cut was thrown. According to this, the 14 feet of limestone and shale overlying the *Whitfieldella* bed are to be assigned to the Osgood beds. The great thickness of clays forming the main element of the Osgood beds elsewhere were removed here before the deposition of the Devonian. The equivalents of the Laurel limestone, of the Waldron shale, and of the Louisville limestone are also gone. The result of all of my investigations for the last five years in Ohio, Kentucky, and Indiana have tended to confirm the conclusion that at the close of the Upper Silurian a considerable part of the folding which now constitutes the Cincinnati axis took place; that a period of denudation took place, removing most strata from the axis of this fold, and proportionally smaller amounts from its flanks; and that the Devonian rests uncon-

formably upon the denuded Upper Silurian rocks upon the flanks of the axis, and that it rests upon the Lower Silurian upon the middle portions of this axis. These observations will be soon ready for publication.

B.—CLINTON.

II.—KENTUCKY. *b*, WESTERN COUNTIES.

Owing to the identification of the Crab Orchard shales as Clinton, Mr. Linney was obliged to refer all real Clinton exposures, wherever found, to the next lower-lying formation, his Medina. This is true in the reports on all the counties lying west of the Cincinnati anticlinal—Lincoln (1882), Garrard (1882), Nelson (1884)—and northward, wherever he thought he could recognize the Crab Orchard shales. The limestone which he identifies as Medina at James's Mill is unquestionably Clinton (Lincoln County, 1882).

A number of other errors occur. In the report on Washington County (1882), Linney refers to possible remains of Clinton iron ore beds (page 20). Since the oölitic iron ore bed of the Clinton seems never to have extended farther west than the summit of the present Cincinnati anticlinal, it is difficult to determine what it was that Linney found, and identified as Clinton. The Clinton in the section east of Wheatley's branch is difficult to recognize; indeed, this is true of the entire upper section. The Clinton is the rock just beneath the heavy bed of clays at the summit of the section.

The real Clinton of Henry County does not contain chert beds (Linney, 1887). Both the Lower Silurian and Upper Silurian contain chert across the Ohio River, near Charlestown Landing, in Indiana. Owing to the fact that Linney includes the Clinton, Osgood shale and Laurel limestone in his Clinton, in Oldham County (1887, pages 11 and 12), it is not impossible that the cherty Clinton of Henry County is the Laurel limestone. The Laurel limestone includes chert, and was identified as Clinton in Oldham County, as already stated.

Dr. W. T. Knott follows Mr. Linney in calling the Crab Orchard shales *Clinton*. Moreover, he places the rocks underlying the Crab Orchard shales in the Medina. The Medina of both Linney and Knott includes all the strata lying below the Crab Orchard shales and above the "coral" bed. The coral bed is a series strata only a few feet thick, characterized by the presence of an unusual number of corals, such as *Favistella stellata*, *Columnopora sp.?*, and *Columnaria*. It is found at the base of the Madison bed, or Linney's Medina. (Linney's Medina includes both the Madison bed and also the Clinton, in the counties extending from Garrard County northwestward.) It so hap-

pens, however, that along the Louisville & Nashville Railroad in western Marion County and in the adjacent parts of Nelson County, there is a bed with *Tetradium* at the top of the Madison bed, within a short distance of the Clinton base. Dr. Knott did not recognize that the *Tetradium* bed was at a higher level than the bed which he usually took as the base of his Medina section, and he therefore made the *Tetradium* bed the base of the Medina at Coon Hollow, New Hope, and at the Marion-Nelson County line. While this still leaves the real Clinton in the Medina as heretofore, the Medina at these localities does not include the Madison bed. But the Madison bed is Linney's typical Medina rock, the Clinton being placed in the Medina only because it is a much thinner formation in this part of Kentucky, so that it was not suspected that it represented an age quite distinct from the main mass of sandy limestones below, which formed Linney's typical Medina.

B.—CLINTON.

III.—OHIO.

The Clinton was correctly identified by Prof. E. Orton at the very beginning of the operations of the Second Geological Survey, and no error has been made in any of the reports of this survey. The presence of the oölitic iron ore at the top of the Clinton is noted at various points between Adams County and the Todd's Fork locality in Clinton County. The presence of chert is recorded in Adams and Highland counties. The conglomerate in the Clinton at Belfast in Highland County is described. The following are the main references to the Clinton in the reports of the survey: Report of Progress for 1869 (1871), page 148; Report of Progress for 1870 (1871), pages 257, 263, 268, 269, 270, 296, 298, 299; Volume I (1873), pages 62, 103, 127, 452, 453, 463; Volume II (1874), pages 663-667, 674; Volume III (1878), pages 2, 5-7, 384-386, 400, 406-408, 441-443, 478-480; Volume V (1884), pages 371, 372, 611; Volume VI (1888), pages 11-13, 705, 727; Volume VII (1893), pages 10-11, 518.

In the third volume of the survey a list of fossils found in the Clinton is given (pages 415, 416). *Lichenalia concentrica* does not occur in the Clinton. *Atrypa nodostriata* is *Atrypa marginalis*, and *Zygospira modesta* is a small specimen of the same *Atrypa*. *Orthis circulus* must be a fairly large specimen of *Orthis elegantula*, and *Streptorhynchus subplana* does not occur in the Clinton. *Cyclonema bilix* is a Lower Silurian species. For the Clinton species described from the Clinton of Ohio, the name *Cyclonema daytonensis* may be suggested.

C.—OSGOOD BEDS.

I.—INDIANA.

The first geologist in Indiana to distinguish the shaly and clayey beds (Osgood) at the base of the Niagara from the rest of the Niagara formation, and to give them a separate designation, was Dr. M. N. Elrod. (Report on Decatur County, Twelfth Report of Indiana Survey, 1883.) He recognized in it the upper thin strata of shale (upper Osgood shale), the intermediate thin flag (Osgood limestone), and the thicker beds of marl at the base (lower Osgood shale). (Page 108.) But, judging from some of his subsequent determinations, he failed to recognize the degree of constancy of this order of lithological succession. The separation was made on the basis of lithological characters, not paleontological.

In 1896, I recognized, in a confused way, that the Lower Niagara beds north of Osgood contained many fossils distinct from those farther up the series, especially distinct from those in the Waldron bed. I therefore referred to them as forming the Lower Osgood phase of the Laurel formation. (An Account of the Middle Silurian Rocks of Ohio and Indiana, Journal of Cincinnati Society of Natural History, February, 1896, pages 190, 191.)

Having learned in conversation with Mr. E. O. Ulrich, who had made considerable collections in this formation at Osgood, and along Big Creek, that he had become satisfied that this represented a horizon very distinct from the Waldron, I began to investigate this formation more carefully, and gave a much more accurate account of its lithological features, as far as its exposures along Big Creek and northward in the area then being investigated are concerned, in my report on the Geology of the Middle and Upper Silurian Rocks of Clark, Jefferson, Ripley, Jennings and Southern Decatur Counties (Twenty-first Report of the Indiana Survey, 1897). The name Osgood beds was here first applied to this formation.

In the Twenty-second Report of the Indiana Survey (1898), the lithological study of the Osgood beds was continued for the more northern counties of Indiana.

C.—OSGOOD BEDS—CRAB ORCHARD SHALES.

II.—KENTUCKY.

The Osgood beds are represented in central and southeastern Kentucky by a thick series of clays which merge northward into clayey shales. In the neighborhood of Crab Orchard they were called Crab

Orchard shales by M. Linney, and were supposed to be Clinton. Mr. Linney was not very successful in tracing these shales and clays from the type locality northward, nor in identifying them where they merge into the Osgood shales on approaching the Ohio River opposite Indiana.

The shales at Crab Orchard were erroneously referred by Mr. Linney to the Clinton. Hence, the corresponding clayey shales, in Lincoln (1882), Garrard (1884), Nelson (1884), Marion (by W. F. Knott, 1885), and Oldham counties, are also referred to the Clinton.

In the reports on Clark (1884, pages 27, 28), Montgomery (1884, page 59), Mason (1885, page 14), Bath (1886, pages 21, 22), and Fleming (1886, pages 69-71), the corresponding shales are more correctly referred to the Niagara. It was not known, however, that they were the Crab Orchard shale, but it was supposed that the Crab Orchard shales merged into the Clinton on going northward, and that the clayey shales of the counties in question represented the Niagara shale (Fleming County report, 1886, pages 70, 71), at the base of the Niagara, in Ohio, and this is their correct position.

In the report on Oldham County (1887), the real Clinton is made the base of Linney's Clinton. The 15 feet of blue Crab Orchard (Osgood of Foerste) shales, and the 30 feet or more of Niagara rock (Laurel of Foerste) overlying the same, are all classed in the Clinton, the uppermost 20 feet of the limestone being called the cavernous layer (pages 11, 12).

Resting on this cavernous bed (top of Laurel of Foerste) are blue clay shales (Waldron shale of Foerste), and above these is a considerable thickness of limestones (Louisville of Foerste). Linney calls the cavernous bed Clinton. The Waldron bed he places at the base of the Niagara; he must therefore identify it as equivalent to Niagara shale. And the Louisville limestone he identifies as the main mass of the Niagara. He evidently did not know of the presence of two clays in the Niagara—one at the bottom, and one near or above the middle.

Linney's identification of the Waldron shale as the Lower Niagara shale, and the underlying Niagara (Laurel) limestone as Clinton, is exactly matched by a note in the last volume of the Indiana Survey, which erroneously credits Mr. A. F. Foerste with the belief that the limestones below the Waldron shale are Clinton.

The Crab Orchard shales are correctly referred to a position above the Clinton, and are made equivalent to the Great Marl bed of Adams County in Ohio, by Dr. D. D. Owen (in Volume 3, Old Series. Kentucky Survey, 1857), in Lewis County, pages 120, 125, and Bath County, page 130. The uncertainty left by the few references of

Prof. N. S. Shaler, in the third volume of the Kentucky Survey, 1877, have already been commented upon in connection with the discussion of the Clinton of Kentucky.

The existence of the Osgood shale as a member of the Panola formation on the eastern side of the Cincinnati axis in Kentucky has been already commented upon in the discussion of the Clinton formation of this section of the State.

C.—OSGOOD BEDS—NIAGARA SHALE.

III.—OHIO.

At the base of the Niagara in Ohio are several feet—two to five—of hard, fine-grained, white limestone, which have been called the Dayton stone. The following are the chief references to this stone in the literature of the survey: Report of Progress for 1869 (1871), page 149; Report of Progress for 1870 (1871), pages 272, 297-302; Volume I (1873), pages 104, 465; Volume II (1874), page 668; Volume III (1878), pages 5, 386, 409; Volume V (1884), pages 613-616; Volume VI (1888), page 13; Volume VII (1893), pages 12, 519.

Above the Dayton stone is a series of rocks which vary considerably in different parts of the State, but which evidently correspond stratigraphically to the Osgood beds of Indiana. In the southeastern part of the Silurian area, in Adams and Highland counties, the series consist of clayey shales of considerable thickness, often exceeding 100 feet. North of Hillsboro, thin fragile courses of shaly limestone begin to replace the clayey shales, and in the more northern and northwestern counties the lower courses are replaced chiefly by a poor quality of limestone, readily weathering, while the upper more shaly courses are very calcareous. In Clarke and Montgomery counties the shale series is reduced to 10 to 15 feet. In the Ohio reports the shale series is called the Niagara shale. The West Union cliff may correspond to the limestone courses in the upper part of the Osgood beds in Indiana and western Kentucky, but it has so far not been sufficiently investigated to admit of correlation. The following are the chief references to the Niagara shale in the literature of the survey: Report of Progress for 1870 (1871), pages 272, 297, 302; Volume I (1873), page 465; Volume II (1874), page 669; Volume III (1878), pages 7, 386; Volume V (1884), page 615; Volume VI (1888), page 13; Volume VII (1893), pages 11-12.

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A REPORT UPON THE WALDRON SHALE AND ITS HORIZON,

In Decatur, Bartholomew, Shelby and Rush Counties, Indiana, together with
Such Other Information concerning the Region Surveyed, as is
of Probable General Interest.

BY J. A. PRICE.

INTRODUCTORY.

As only six weeks were spent in the field gathering data for this report, the writer wishes to state at the outset that many interesting observations were omitted, especially touching upon the physiographical and glacial phase of the subject, and that the line marking the horizon of the Waldron shale, as indicated on the accompanying map, is, in detail, correct only along some of the larger streams where outcrops were numerous. It is believed, however, that in general the location of the shale horizon, one of the principal features of this report, is correct.

The work was somewhat handicapped by the heavy drift and the alluvial deposits distributed over a large portion of the area mapped. In fact, at quite a number of places, the drift was so heavy that the exact locating of this line was not only unsatisfactory but altogether impossible.

On the accompanying map, along the streams where outcrops were numerous, a continuous line marks the horizon of the Waldron shale. At places the shale was observed, while at other points probably the base of the overlying limestone or top of the underlying limestone was noted, in which case the line was drawn as a continuous one. The broken line indicates the probable horizon of the shale following the contour line as modified by the assumed dip of the rocks. The dash and two dots indicate that portion where the drift is heavy, completely covering all exposures, and where the location of the line is merely an arbitrary matter.

An effort was made to work out the eastern limit of the shale in the drifted area from well sections, but, owing to the limited and more or less confused condition of the knowledge obtainable through the farmers and well men, this effort was abandoned as altogether unprofitable. An inspection of the accompanying map will reveal the fact that the line marking the eastern extension of the shale in Decatur County is, indeed, a general one. Quite a number of wells are located on the map, while only comparatively few well sections are incorporated in the body of the report. The omission of the sections is due largely to the fact that they throw but little, if any light, upon the distribution of the Waldron shale. Well men invariably report a continuous limestone formation down to the Lower Silurian shales. Only in very few instances was the shale reported. It is quite probable that over a large part of the territory lying east and northeast of Greensburg, included in the shale area, the shale, if ever deposited, has been removed. This is to receive further discussion under the heading, "The Probable Eastern Extension of the Waldron Shale in Decatur County." At present, suffice it to say, that this part of the work was attended with no few inconveniences, due largely to the presence of a rather heavy drift.

Incidentally, some little attention was given to the Laurel limestone and Osgood beds.*

In eastern and southern Decatur County a number of gas wells were located, marking the limit of the gas field in that section of the county. Largely for the sake of simplicity, the detailed discussion of the subject in hand will be taken up by counties.

DECATUR COUNTY.

This county is situated in the southeastern part of the State, and has an area of 380 square miles. Greensburg, the county seat, locally known as the "Lone Tree City," is located near the center of the county. That part of the county mapped in this report includes all of townships 11 N., R. 9 and 10 E.; 10 N., R. 8, 9 and 10 E., and 9 N., R. 8 E., and parts of the townships 8 N., R. 8 and 9 E.; 9 N., R. 9 E.; 11 N., R. 8 E., and 12 N., R. 8, 9 and 10 E. These townships and parts of townships comprise all of the county except the eastern and southeastern parts, which lie outside of the eastern extension of the Waldron shale. Quite a number of observations were made outside of the mapped territory, but as this report is to be primarily a

* For fuller report upon the Laurel limestone see the reports of this Department for 1896 and 1897.

report upon the Waldron shale, but few of these observations have been incorporated in the report.

The outcropping strata in the unmapped area belong to the Upper and Lower Silurian formations. The Laurel limestone forms a large per cent. of the outcrops in the eastern part of the county. This limestone is quarried at a number of places along the streams, and furnishes not only building stone for local uses, but is shipped to various points in and outside of the State.*

Drainage and Topography.—The northwestern part of the county is drained by Big Flat Rock Creek, Little Flat Rock Creek and Clifty Creek. The last mentioned stream, with its branches, crosses the county from a point one mile southwest of Richland, Rush County, to a point one-half mile west of Adams. The central and southwest parts are drained by Sand Creek and its tributaries.

The topography runs from narrow, level creek valleys to rather high, irregularly dissected uplands, with hills rising from 30 to 75 feet or more above the adjacent creek valleys. The topography in the main is glacial and post-glacial. The streams usually have narrow flood plains, with here and there rather steep banks. In fact, there are two distinct types of valleys; viz., the typical post-glacial valley with a narrow or no flood plain, and the post-glacial valley as modified by pre-glacial valleys where the streams usually have flood plains and gently sloping banks. The former type is seen along Clifty Creek at Adams and Milford, and a number of other places, while good examples of the latter are seen along Flat Rock Creek.

It is more than probable that during pre-glacial and glacial times Little Flat Rock Creek and probably Big Flat Rock Creek left their present course south of Downeyville and followed down the old channel of Flat Rock Creek, as marked on the accompanying map, emptying into Clifty Creek above Milford. The old valley is very marked, passing in a curved line from a point southwest of the junction of Big Flat Rock and Little Flat Rock creeks to the valley of Clifty Creek in Section 4, north of Milford. The average width of this valley is about 375 yards, with banks running from 20 to 35 or 40 feet in height. The narrowest point is near the southern end, where it is not over 250 yards wide. The bottom of the channel is covered with drift, and no wells have been dug to determine the thickness of the deposit. At present Hog Creek and Pond Branch occupy the lower half of this old valley.

* See same as above.

SURFACE GEOLOGY.

This county is included in the glaciated portion of the State. The northwestern half of the county is included in the Wisconsin till plain, and the southeastern part is covered with the loess-covered Illinoian drift sheet. The southeastern limit of the Wisconsin sheet is marked by a well-defined, though not conspicuous moraine, which crosses the county from the northeast to the southwest corner, passing south of Greensburg. Some of the best exposures, showing the character of this morainic deposit, are found south of Greensburg, in sections 13 and 24, and along Sand Creek in sections 14 and 23.

DETAILED DISCUSSION OF THE WALDRON SHALE AND ITS HORIZON.

Stratigraphically, the Waldron shale belongs to the upper part of the Upper Silurian, but does not form the top of this formation, as has been previously correlated by some writers. At a number of places, to be indicated below, some 10 or 12 feet of intervening limestone is to be found between the shale and the base of the Devonian. This limestone, we believe, belongs to the Niagara, and forms the top member of the Upper Silurian in this territory, corresponding stratigraphically to Foerste's Louisville limestone, farther south.*

As it is customary to give local names to outcrops, especially where the relation between such formations and their stratigraphic equivalent is uncertain, we shall call this limestone, occurring in part of the area mapped, overlying the Waldron shale, and below the sandy limestone, which seems to be the base of the Devonian, the Hartsville bed, realizing the fact, however, that this formation is not very prominent in the immediate vicinity of Hartsville. To follow this formation south and determine its exact relation to the Louisville division would be a very interesting piece of work for the paleontologist. At a number of places, some nine or ten feet of limestone was observed resting upon the Waldron shale, the correlation of which is very uncertain, due to the absence of fossils; while, at other places, the base of the Devonian rests upon the Laurel limestone, the intervening strata, including the Waldron shale, having been removed by subsequent erosion, if ever deposited.

* For fuller report upon this limestone see the reports of this Department for 1896 and 1897.

Below is given a generalized section of the stratigraphy of this area, indicating the relative position of the different strata, together with their maximum and minimum thickness.

	<i>Ft.</i>
1. Devonian	0 to 40
2. The Hartsville limestone, the stratigraphical equivalent of the Louisville limestone.....	0 to 10
3. Waldron shale	0 to 6?
4. Laurel limestone	15 to 40?
5. Osgood limestone and shale.....	15 +

EASTERN EXTENSION OF THE WALDRON SHALE.

As is stated above, the exact location of the eastern limit of this shale, due to existing conditions, was impossible. By an inspection of the accompanying map, it will be seen that the line approximating the eastern limitation of the shale extends in almost a due northern direction, from a point one and one-half miles northwest of Layton's mill, to a point two miles west of New Salem, in Rush County. Southeast of Greensburg, along Cobb's Fork of Sand Creek, the line turns southwest, following in a curved line across the southwest corner of T. 10 N., R. 10 E., to "Dry" falls, one-half mile southeast of Greensburg, where it turns and follows down the creek to the mouth of a branch of Sand Creek, at which point it turns north to Greensburg, and then down Sand Creek, following rather close to the stream down to Harris City, where it leaves the stream and falls west of Horace and Old Lett's Corner, but turns east and passes east of Westport. The location of this line was determined largely by well sections, and owing to the limited number of wells, together with a greater limitation of well sections, its location is, indeed, very uncertain. In a general way, the sections reported west of this line contain either the Waldron shale or what seems to be the base of the Devonian, while those east of the line contain only the shale and limestone of the Upper and Lower Silurian formations. Below are given some of the sections found east of the line, as indicated on the map.

At Mechanicsburg, in Secs. 11 and 12, T. 10 N., R. 10 E., the following section was reported by Mr. Johnson:

	<i>Ft.</i>
1. Drift	98
2. Hard, blue limestone.....	30
3. Sandy clay	3
4. Shale	2
5. Hard rock	1

The limestone in the foregoing section was considered as the Laurel limestone and the shale as the Osgood shale.

Section at the Big Four quarries at Rossburg, in Sec. 8, T. 10 N., R. 11 E.:

	<i>Ft.</i>	<i>In.</i>
1. Drift	10	..
2. Hard, blue Laurel limestone.....	..	3
3. Hard, blue Laurel limestone.....	..	5
4. Hard, blue Laurel limestone.....	..	6
5. Hard, blue Laurel limestone.....	..	10
6. Hard, blue Laurel limestone.....	..	9
7. Hard, blue Laurel limestone.....	..	7
8. Hard, blue Laurel limestone.....	..	6
9. Hard, blue Laurel limestone.....	..	6
10. Hard, blue Laurel limestone.....	1	..
	<hr/>	<hr/>
	15	4

Section at the bridge across the small stream in the northwest quarter of the northwest quarter of section 35, one mile northwest of Smyrna:

	<i>Ft.</i>	<i>In.</i>
1. Drift	6	..
2. Hard, blue limestone.....	..	10
3. Hard, blue limestone.....	..	3
4. Hard, blue limestone.....	..	4
5. Hard, blue limestone.....	..	5
6. Hard, blue limestone.....	..	8
7. Hard, blue limestone.....	..	6
8. Hard, blue limestone.....	..	8
9. Hard, blue limestone.....	..	8
10. Hard, blue limestone.....	..	6
11. Hard, blue limestone.....	..	9
	<hr/>	<hr/>
	11	7

The limestone, which is evidently the Laurel limestone, is free from chert and would make very good stone for bridge work and building purposes. Above this exposure, in a small ravine north of the road, is an old limekiln, where a considerable amount of lime has been burned. The rock is reported as fairly good for this purpose.

Section of the exposed strata at the stone bridge across Cobb's Fork, near the southwestern corner of Sec. 35, 9 N., R. 10 E., two and one-half miles southwest of Layton's mill:

	<i>Ft.</i>
1. Drift and loose chert.....	20
2. Hard, blue limestone (Laurel).....	4
3. Bed of creek.....	0
	24

Near the bed of the creek is a thin layer of chert.

Outcrops along Cobb's Fork of Sand Creek, in Secs. 21 and 28, 10 N., R. 10 E., four miles southwest of Greensburg:

Above the stone bridge, near the southwest corner of section 21, in the bed of the creek, a number of loose, sandy limestone boulders were observed, which seem from a lithological standpoint to be the equivalent of the sandy limestone found along Sand Creek, southeast of Greensburg. At a point or two in the east bank of the creek, and one hundred yards or more above the bridge, this limestone seems to be in position, with a probable total thickness of not over three feet. Below the limestone is six feet of loose chert and drift. Following up the stream for one-half mile the exposures are covered. One mile above this point, in the bed of the creek, in the northwest corner of section 22, is a fine exposure of five feet of Laurel limestone. The Devonian, if present east of the creek, correlating the sandy limestone as Devonian, probably occurs as a detached body, as indicated on the accompanying map.

GREENSBURG AND VICINITY.

Below is given a series of sections taken along Sand Creek, southeast of Greensburg one-quarter of a mile, beginning at "Dry" Falls, 250 yards below the railroad bridge.

	<i>Ft.</i>	<i>In.</i>
1. Hard, sandy, impure limestone.....	1	3
2. Softer, sandy limestone.....	..	9
3. Soft, sandy limestone.....	..	5
4. Sand, clay and limestone fragments.....	..	6
5. Hard, irregularly bedded limestone.....	2	..
6. Bed of creek	0	..
	4	11

Limestone No. 5, in the foregoing section, has quite a lot of soft to hard chalk white chert mixed promiscuously through it. No. 1 forms the top of the falls. The total height of the falls is three feet. The exposed sandy limestone, correlated as Devonian, seems to represent the total thickness of this formation at this place.

Section of the south bank of the creek, 205 yards below the falls:

	<i>Ft.</i>	<i>In.</i>
1. Hard, sandy limestone.....	1	3
2. Sand, clay and limestone.....	1 to 3	
3. Hard, flinty limestone.....	2 to 4	
4. Hard, bluish limestone.....	2 to 4	
5. Soft, whitish chert.....	½ to 1½	
6. Hard, bluish limestone.....	3	
7. Hard, blue limestone mixed with chert.....	1	..
8. Hard, blue, cherty limestone.....	6	
9. Hard, blue limestone.....	5	
10. Hard, blue, cherty limestone.....	4	
11. Hard, blue, cherty limestone.....	5	
12. Bed of creek.....	0	..
	<hr style="width: 100px; margin-left: auto; margin-right: 0;"/> 5	<hr style="width: 100px; margin-left: auto; margin-right: 0;"/> 2½

Section twenty yards below the above section:

	<i>Ft.</i>	<i>In.</i>
1. Hard, sandy limestone.....	2	..
2. Clay, sand, chert and limestone.....	..	6
3. Hard, blue limestone.....	2	
4. Limestone.....	8	
5. Hard, blue, cherty limestone.....	7	
6. Hard, blue, cherty limestone.....	8	
7. Hard, blue, cherty limestone.....	8	
8. Hard, blue, cherty limestone.....	5	
9. Hard, blue, cherty limestone.....	6	
10. Bed of creek.....	0	..
	<hr style="width: 100px; margin-left: auto; margin-right: 0;"/> 6	<hr style="width: 100px; margin-left: auto; margin-right: 0;"/> 2

Section of the west bank of the creek, 175 yards below the foregoing section:

	<i>Ft.</i>	<i>In.</i>
1. Drift.....	10	..
2. Shaly, broken, sandy limestone.....	3	..
3. Hard, whitish, sandy limestone.....	2	..
4. Hard, blue limestone.....	..	4½
5. Stratum of hard, blue limestone with a layer of chert near the top and bottom.....	..	7
6. Hard, blue limestone, with chert near the bottom ..	3	
7. Hard, blue limestone.....	6	
8. Hard, blue limestone.....	8	
9. Hard, blue, cherty limestone.....	7	
10. Hard, blue limestone.....	6	
11. Chert.....	2	
12. Limestone.....	7	
13. Chert.....	2	

	<i>Ft.</i>	<i>In.</i>
14. Cherty limestone.....	..	9
15. Chert .....	..	1
16. Limestone .....	..	8
17. Bed of creek.....	0	..
	<hr/>	<hr/>
	20	10½

Nos. 1, 2, and 3 belong to the Devonian, the other strata belong to the upper division of Upper Silurian.

Section 100 yards farther down the creek, as obtained from exposed strata in the west bank:

	<i>Ft.</i>	<i>In.</i>
1. Arenaceous limestone	1	8
2. Fragmentary limestone .....	..	3
3. Hard limestone .....	..	4
4. Broken limestone, poorly bedded.....	..	4
5. Hard, cherty limestone, irregularly bedded, which breaks down in small, irregular, sharp-cornered pieces	2	..
6. Hard, blue, bedded, cherty limestone.....	4	..
7. Bed of creek.....	0	..
	<hr/>	<hr/>
	8	7

Section 250 yards above the lower bridge and 200 yards below the last of the above sections:

	<i>Ft.</i>	<i>In.</i>
1. Drift	10	..
2. Hard, sandy limestone.....	4	..
3. Hard, blue limestone.....	..	8
4. Hard, blue limestone.....	..	6
5. Bed of creek.....	0	..
	<hr/>	<hr/>
	15	2

At all of the exposures where the above sections were made, the limestone was non-fossiliferous. The Devonian seems to continue along this stream with a thickness of from three to four feet. Below the Devonian is this loose, broken, irregularly bedded cherty limestone, which is quarried a great deal for road and street purposes. The Waldron shale is absent, and was probably never deposited in this locality.

Section along Sand Creek three-quarters of a mile south of Greensburg:

	<i>Ft.</i>	<i>In.</i>
1. Drift	15	..
2. Hard limestone .....	..	4
3. Chert .....	..	2
4. Limestone .....	..	5
5. Chert .....	..	0 to 2
6. Blue to whitish, irregularly bedded limestone	2	6
7. Chert .....	..	3
8. Limestone .....	..	8
9. Limestone .....	..	6
10. Limestone .....	..	5
11. Chert .....	..	0 to 2
12. Hard limestone	1	2
13. Hard limestone	1	1
14. Bed of creek.....	0	..
	22	10

If the Devonian occurs along the creek at this point, the formation is covered. Indications are that the drift rests upon the Niagara.

Along the branch of Sand Creek that passes through Greensburg, the line of parting between the Upper Silurian and Devonian formations follows up the stream to the bridge, on the street that runs south past the depot. Below the bridge and west of the cemetery, some of the Laurel limestone has been quarried for road and street purposes. The stone has its characteristic color, together with its regular bedded condition, the strata thinner, however, than their average thickness. Just below the bridge, and on the north side of the stream, rather high in the bank, is an exposure of an irregular, slightly sandy limestone, which, apparently, is the lithological equivalent of the stratum forming the top of "Dry" Falls and the base of the Devonian. It should be remembered, however, that, owing to the absence of fossils, this correlation was made wholly upon lithological characteristics—a very unsatisfactory and uncertain basis.

One mile west of Greensburg, at the stone bridge across Muddy Fork of Sand Creek, the sandy limestone is exposed in the bed of the creek. In composition it varies from a very sandy to a pure limestone. Its color runs from a light gray to a dirty brown. It is irregularly bedded, non-fossiliferous, and free from chert. Above the bridge, some twenty yards, is a small running fall of a few feet. On the east side of the creek, 100 yards below the bridge, is an old limekiln, where quite a lot of lime, reported as of good quality, has been burned.

The rock used was taken from the bank and bed of the creek. No lime has been burned for a number of years. The kiln was run last by Albert Smith, of Greensburg.

Following down the creek, the Devonian forms the bed of the creek to a point one-half mile or more above Harris City, where the Laurel limestone sets in, thickening rapidly. The Devonian was observed 250 yards below the railroad, in section 10, and at the road crossing near the center of section 21, one and one-fourth miles above Harris City, where it appeared as a sandy, impure limestone. The greater part of the creek bed is drift, the country rock rarely appearing.

The thickness of the drift varies greatly about Greensburg, running from 20 to 150 feet, with a probable average of 50 feet. The greatest thickness is to the north and northeast. Below is given the thickness of the drift in the vicinity of Greensburg, as reported in well sections. At the Hamilton gas well, one and one-half miles north of Greensburg, the drift was reported 80 feet thick; in section 21, four and one-half miles northeast of Greensburg, only 30 feet thick; in section 16, just north of section 21, 28 feet thick; at Kingston, six miles northeast of Greensburg, 40 feet thick; one mile southeast of Kingston, in section 35, 105 feet thick; in section 34, west of section 35, 100 feet thick. Three-fourths of a mile southwest of Kingston the following section was reported: Drift, 78 feet; chert and clay, 10 feet; limestone, 12 feet. Along the road running east from Greensburg, the drift varies from 30 to 70 feet, and on the road running southeast from Greensburg, as far as Layton's Mill, the variation is from 10 to 90 feet. South, along Cobb's Fork of Sand Creek, the drift, on the whole, is not so heavy, due in part at least to the greater denudation in this territory. In sections 9 and 16, two miles southwest of Greensburg, the drift runs from 29 to 50 feet or more. Farther south, in the vicinity of Harris City, the average thickness is probably not over 30 feet. In the vicinity of Horace post-office the drift has a maximum and minimum thickness of 30 and 70 feet. At a mill just southeast of Horace the following section was obtained: Drift, 30 feet; hard, blue limestone, apparently the Laurel limestone, 20 feet. It was due largely to this section that the line marking the eastern extension of the Waldron shale was drawn west of this point.

At Old Lett's Corner the following section was reported: Drift, 80 feet; shaly rock, 3 feet (?); "hard pan," 2 feet, and hard, flinty limestone, 30 feet. This limestone probably belongs to the Laurel limestone, presumably the upper strata.

CLIFTY CREEK.

All the rock exposures along the head waters of this creek, in this county, belong to the Devonian (?). The greater part of the creek bed is drift, the country rock rarely appearing. Observations were made at the following places, along the creek just north of Ewington post-office, where the following section was obtained:

	<i>Ft.</i>
1. Drift	8
2. Irregularly, thin bedded, white to grayish limestone (Devonian ?).....	5
3. Impure, rather hard, dull colored limestone to bed of creek (Devonian ?).....	4½
	17½

Good exposures are found along the creek from west of the school-house to the road running north at Ewington, and farther. Irregularities in the creek bed, with alternating exposures of limestone and drift, indicate the irregularities of pre-glacial topography. This is especially true just north of Ewington.

Section obtained at the old quarry and limekiln, one-fourth mile below Ewington:

	<i>Ft.</i>	<i>In.</i>
1. Rather sandy limestone, with poorly marked bedding planes	5	..
2. Light grayish, sandy limestone.....	2	11
3. Dull grayish, sandy limestone.....	..	8
4. Dull grayish, sandy limestone.....	1	11
5. Sandy limestone, with chert.....	1	5
6. Dark brown to red colored, impure, sandy limestone	2	5
7. Rather hard, dark brown limestone.....	2	6
	16	10

More than fifteen years ago this limestone was quarried and burned for lime. The lime and quality of rock for this purpose was reported favorable. Above and below this exposure, which is probably 100 yards east and west, the bed of the creek is lower and of drift, suggesting the thought that probably the exposure marks the top of some pre-glacial hill or divide. The drift in this neighborhood is thinner than the average. The limestone, after some little hesitancy, was correlated from a lithological basis as Devonian.

One and one-half miles west of Ewington, where the road crosses the creek at the northwest corner of section 23, all country rock are covered by drift. This is true along the creek for two miles or more. At the point where the road crosses the creek in section 30, two miles northwest of Newburg, there is an exposure of eight inches or more

of impure, sandy limestone in the bed of the creek along the road and extending up the creek 300 yards or more. Over this limestone there is some 20 feet of drift as indicated by the creek banks. The same limestone outcrops in a bed of a tributary of this creek, at the road crossing one-fourth mile south. From this point down the creek to the county line all country rock are covered. In section 31, four miles northwest of Forest Hill post-office, a hard, dark-colored sandy limestone is exposed where the road crosses Middle Fork.

One and one-fourth miles west of Forest Hill post-office, at Mr. Sanders', the following well section was reported:

	<i>Ft.</i>
1. Drift	60
2. Shaly limestone.....	2
3. Quicksand	1
4. Shaly limestone	5
5. Quicksand	1+
	69

Clifty Creek crosses the county in a southwesterly course from the northeast corner to a point two miles south of west of Burney. The Waldron shale is exposed at several places along its course from a point one and one-half miles east of Sandusky to the west county line. The eastern extension of the shale is probably not far from Spring Hill post-office; its covered condition here, as in many other places, makes its exact location impossible. On the accompanying map the line approximating the eastern extension of the shale is about one mile east of Spring Hill post-office. The stream bed both above and below this place is of drift, no country rock being exposed above the southwest quarter of section 5, two miles west of Spring Hill. At this last mentioned place quite a fine exposure occurs in the bed of the stream. It is non-fossiliferous; free from chert; with poor bedding planes, and from lithological characteristics was correlated as Devonian. Two hundred and fifty yards below this point, in the southeast corner of the southeast quarter of section 6, two miles east of Sandusky, is an exposure of the Waldron shale. The shale is poorly exposed near the level of the creek in the north bank. The following imperfect section was obtained at this exposure:

	<i>Ft.</i>	<i>In.</i>
1. Drift	30	?
2. Sandy limestone	2	..
3. Waldron shale	1	6
4. Covered to bed of creek.....	2	..

At this exposure the shale was free from clay and limestone. But very little exposed; occurring at only this one point. The length of the exposure along the bank of the stream was not over two feet.

This point marks the first appearance of the shale in descending Middle Branch. Only a few yards above this exposure limestone occurs in the bed of the creek, and is presumably above the horizon of the shale.

On South Branch, one-fourth mile above where it empties into Middle Branch, the following section was obtained:

	<i>Ft.</i>
1. Drift	20
2. Waldron shale mixed with drift.....	4
3. Limestone free from chert.....	4
4. Cherty limestone to bed of creek.....	3
	<hr style="width: 10%; margin-left: auto; margin-right: 0;"/> 31

Above this point at a number of places in the bed of the creek the Devonian (?) limestone outcrops; in the southwest corner of section 7, the northeast corner of section 18, and in the south half of section 16. A further idea of the stratigraphy of this region is given by the following well section.

Section of Frank Bird's well in the northwest quarter of section 16, two miles northwest of Spring Hill post-office:

	<i>Ft.</i>
1. Drift	27
2. Hard limestone	21
3. Shale (Waldron shale).....	2
4. Flinty limestone	15
5. Hard sandy (?) limestone.....	30
	<hr style="width: 10%; margin-left: auto; margin-right: 0;"/> 95

Section of well in the southeast quarter of the southeast quarter of section 5, one mile west of Spring Hill post-office:

	<i>Ft.</i>
1. Drift	40
2. Solid limestone	25
	<hr style="width: 10%; margin-left: auto; margin-right: 0;"/> 65

The shale seems to be absent in this locality. The depth of the drift ranges from five to twenty feet in the neighborhood of Spring Hill post-office.

The Waldron shale is exposed at the top of the stone quarry one-half mile east of Sandusky. The following section was obtained at the quarry:

	<i>Ft.</i>	<i>In.</i>
1. Covered	8	..
2. Clay shale	2	..
3. Soft, impure, shaly, dirty to light colored limestone	1	6
4. Bedded Laurel limestone.....	8	..
	19	6

The upper two feet of the Laurel limestone lies in courses from two to four inches in thickness; the lower six feet lies in courses from four to ten inches in thickness, with a union of these strata at places forming much thicker course, at one place measuring four feet. The one and one-half feet of rubble limestone above the Laurel limestone belongs with the Waldron shale, having the shale fossils and forming in a way the transition from the shale proper to the Laurel limestone. The Waldron shale, proper, is of a light blue to a drab color, with an abundance of fossils. From the bottom of the quarry to the bed of the creek is about five feet, making a total thickness of about 15 feet of Laurel limestone exposed at this place. This limestone seems to be of a very good quality and well adapted in the thickness of its courses for building, bridge, and flagging purposes.

Section of the north bank of the creek, 100 yards above Douglas Hole, one-fourth mile east of Sandusky:

	<i>Ft.</i>
1. Hard, bluish crystalline limestone, with crinoid stems and corals.....	2
2. Waldron shale.....	4
3. Thin, imperfectly bedded limestone.....	4
4. Irregularly bedded, cherty limestone.....	5
5. Covered to bed of creek.....	4
	19

The Waldron shale is quite calcareous, containing irregular masses of limestone. It is very fossiliferous, the fossils, apparently evenly distributed from bottom to top. In No. 3 in the foregoing section there is a layer of crinoidal limestone near the center.

Following up North Branch to the center of section 1, three-fourths of a mile northeast of Sandusky, an exposure of the Waldron shale is found in the west bank of the creek above the road crossing. The following section was obtained at this exposure:

	<i>Ft.</i>	<i>In.</i>
1. Drift, as seen in sloping hill.....	30	?
2. Fossiliferous shale, with a pale drab to pale dirty color where weathered.....	3	?
3. Cherty Laurel limestone.....	2	..
4. Covered to bed of creek.....	8	..
	43	..

Along the stream above this point, as far as examination extended, the country rock were covered with drift. Observations were made along the road and where the road running east from Williamstown crosses the stream.

Section of the north bank of Clifty Creek, between the railroad bridge and the pike bridge, north of Sandusky:

	<i>Ft.</i>	<i>In.</i>
1. Drift	2	..
2. Sandy limestone	1	..
3. Waldron shale	4	..
4. Hard, blue Laurel limestone.....	6	6
5. Hard, blue Laurel limestone.....	7	7
6. Hard, blue Laurel limestone.....	7	7
7. Hard, blue Laurel limestone.....	5	5
8. Hard, blue Laurel limestone.....	3	3
9. Hard, blue Laurel limestone.....	3	3
10. Hard, blue Laurel limestone.....	11	11
11. Creek bed	0	..
	10	6

At this exposure the Waldron shale has but few fossils, and with six inches of shelly limestone at its bottom. This limestone belongs with the shale and represents the transition from the period of shale deposition to the formation of the limestone. Years ago limestone was quarried at this place. The same strata are poorly exposed east of the railroad bridge.

Following down the stream no good exposures occur between this point and Adams. In general the valley is wider than the average width. The stream seems to follow an old pre-glacial valley at this point in its course.

Along Shiloh Branch, a tributary emptying into Clifty Creek two miles above Adams, all exposures were covered. The following section of the gas well east of the cross roads at the north side of section 22, three miles northeast of Adams, was reported:

	<i>Ft.</i>
1. Drift	9
2. Limestone	5
3. Shale	6?
4. Limestone	?
5. Shale and limestone.....	?
6. Trenton at 880 feet.	

Combined section of exposures along Clifty Creek, south of railroad bridge west of Adams:

	<i>Ft.</i>	<i>In.</i>
1. Drift	4	..
2. Soft, sandy, irregularly bedded limestone.....	2	6
3. Sandy limestone	1	6
4. Hard, sandy, cherty, whitish limestone.....	1	..
5. Very variable, non-fossiliferous, sandy limestone..	4	6
6. More or less irregularly bedded, hard whitish and blue limestone, with discontinuous chert layers..	5	..
7. Bed of creek	0	..
	18	6

Detailed section of No. 6 in the foregoing section:

	<i>Ft.</i>	<i>In.</i>
1. Hard limestone	8
2. Hard limestone	1	6
3. Chert layers	3
4. Soft, whitish to grayish limestone.....	..	7
5. Chert layers	1
6. Hard, streaked, sandy limestone.....	..	6
7. Whitish to grayish friable sandy limestone.....	..	7
8. Chert layer, soft.....	..	2
9. Hard, pale blue to reddish sandy limestone.....	..	5
10. Impure, whitish limestone.....	..	7
11. Chert layer	½
12. Limestone	1½
13. Bed of creek.....	0	..

The strata have a decided dip to the south. The occurrence of the discontinuous chert beds suggests the upper strata of the Laurel limestone, but if this correlation be true, the occurrence of the intervening limestone strata is exceptional. From a lithological standpoint, the sandy limestone suggests the Devonian. It was at first thought that No. 5, in the foregoing section, marked the horizon of the Waldron shale, but later, owing to the absence of fossils, this correlation was considered very questionable. It is the writer's opinion, however, that the bed of the creek is Silurian and the upper strata exposed in the stream banks are Devonian, with the Waldron shale absent. As will be seen later, the non-appearance of the Waldron shale is not exceptional along this stream.

Section of the west bank of Clifty Creek, one-fourth mile below the iron bridge below Adams:

	<i>Ft.</i>
1. Massive, impure, sandy limestone.....	11

This outcrop is divided by poorly marked bedding planes into three strata:

	<i>Ft.</i>
A rather hard, sandy limestone.....	4
A sandy limestone.....	3
A sandy limestone.....	4

These strata form a projecting ledge or cliff along the creek. Below the lowest ledge given in the section, no strata are exposed to the bed of the creek. On the opposite side of the stream, and corresponding in height to the part covered, is an exposure of two feet of rather hard, blue to gray limestone, divided into courses of two to five inches. The correlation of this exposure is very uncertain. Probably the greater part belongs to the Devonian.

A section of the south bank of Clifty Creek, 100 yards below the stone arch across the creek at the southeast corner of section 26, one and one-half miles northeast of Milford, is as follows:

	<i>Ft.</i>	<i>In.</i>
1. Massive, sandy (?) limestone.....	14	..
2. Hard, reddish dull-colored limestone.....	3	6
3. Blue to drab shale.....	..	½ to ¾
4. Hard, blue limestone.....	..	8
5. Very hard, blue limestone.....	..	1
6. Hard, blue limestone.....	..	10
7. Persistent chert streak.....	..	1
8. Hard, cherty limestone.....	..	10
9. Hard, cherty limestone.....	..	8
10. Thin-bedded, cherty limestone.....	1	2
11. Cherty limestone.....	1	1
12. Hard, blue limestone to bed of creek.....	..	10
	23	9¾

No. 1 is not as sandy as what seems to be the same stratum at Adams. The shale under No. 3 is not persistent, running for only 100 yards along the cliff and then disappearing. The thickness of the upper half is constant, while the lower half varies, entirely disappearing near the south end of the cliff. The position of this thin streak of shale lithologically indicates the Waldron shale, and probably should be so correlated. Nos. 8, 9, and 10, 50 yards farther down the stream, are divided into some five or six strata of alternating limestone and chert layers, the latter running from one to three inches in thickness, and the limestone layers from two to five inches.

A small unconformity occurs at this point. See sketch below.



Fig. 1. Unconformity along Clifty Creek, 1¼ miles northeast of Milford.

a-b—Line of unconformity.
 x—Lower end of shale streak.
 yy—Layers of chert.

The total length of unconformity, as exposed, is probably not over 45 yards.

Section of the south bank of Clifty Creek, 100 yards below the stone arch across the stream, one-half mile north of Milford:

	<i>Ft.</i>	<i>In.</i>
1. Soft, sandy limestone.....	5	..
2. Sandy, variable, irregularly bedded limestone.....	2	6
3. Hard, cherty limestone.....	..	6
4. Hard, blue Laurel limestone.....	..	4
5. Hard, blue Laurel limestone.....	1	2
6. Hard, blue Laurel limestone.....	..	10
7. Hard, blue Laurel limestone.....	..	11
8. Covered to bed of creek.....	1	..
	12	8

No. 2 in the foregoing section presents the appearance, in places, at least, of a stone wall built of irregular, angular pieces. This probably corresponds to the Hartsville bed, and marks the horizon of the Waldron shale which is absent. The hard, blue limestone below No. 2 is unquestionably the Laurel limestone. Its outcrops are non-fossiliferous. Some little stone has been quarried here for bridge purposes.

Section of the west bank of Clifty Creek, 20 yards below the west end of the bridge across the creek, at Milford:

	<i>Ft.</i>	<i>In.</i>
1. Soft, sandy limestone.....	4	..
2. Harder, sandy limestone, irregularly bedded.....	3	6
3. Waldron shale .....	..	10
(a) Drab shale .....	..	3
(b) Shale and shaly limestone.....	..	4
(c) Drab shale .....	..	4
4. Regularly bedded Laurel limestone—		
(a) Hard, blue limestone.....	..	4
(b) Hard, blue limestone.....	..	5

	<i>Ft.</i>	<i>In.</i>
(c) Hard, blue limestone.....	..	3½
(d) Hard, blue limestone.....	..	4
(e) Hard, blue limestone.....	..	5
(f) Hard, blue limestone.....	..	3
(g) Hard, blue limestone.....	..	8
(h) Hard, blue limestone.....	..	10
(i) Hard, blue limestone.....	1	4
(j) Hard, blue limestone.....	..	10
(k) Hard, blue limestone.....	1	..
(l) Cherty limestone to bed of creek.....	2	..

It seems very questionable whether the Hartsville bed is present at this place. Above the bridge there is seven feet of irregularly bedded limestone, which may represent this bed. In the foregoing section the limestone overlying the Waldron shale is also irregularly bedded and may represent the Hartsville bed, but owing to the lack of fossils and characteristic lithological traits, the correlation is rendered very uncertain.

A section of the center of the cliff on the south side of Clifty Creek, 250 feet below the iron bridge west of Milford:

	<i>Ft.</i>	<i>In.</i>
1. Massive, sandy limestone.....	12	..
2. Irregularly bedded limestone (Hartsville) (?)... 3	3	..
3. Waldron shale .....	..	2 to 5
4. Well defined layers of Laurel limestone, varying in thickness from 2 to 14 inches.....	11	..
5. Bed of creek.....	0	..
	—	—
	26	5

The horizon of the shale is marked at this place, although the shale is very thin. At the upper end of the cliff the shale is covered, and following down the cliff the shale grows thinner with a maximum thickness of not over one inch at the lower end, which probably represents the total deposition. The heavy, massive limestone above weathers more slowly than the shale and adjacent layers of limestone, forming a projecting ledge. The figure on page 101 represents the cliff in profile.

The views on Plate I represent fairly well the exposed strata at this place, together with some of their physical characteristics. In view (a) the position of the Waldron shale is located by Mr. Fisher's hand where the shale is one and one-half inches thick. In front of him the shale disappears; its horizon is indicated, however, by the top of the irregularly bedded Laurel limestone. Behind him, the thin shale streak is easily recognized. Above the shale there is some three feet

or more of irregularly bedded limestone, the correlation of which is very uncertain. It probably represents the Hartsville bed, but owing

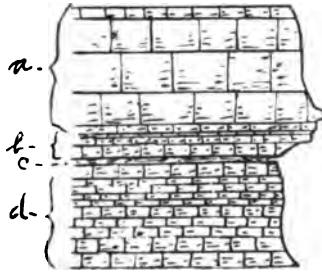


Fig. 2. Profile of south cliff of Clifty Creek, Milford, Ind.

- (a)—Base of the Devonian (?).
- (b)—Hartsville bed (?).
- (c)—Waldron shale.
- (d)—Laurel limestone.

to the non-fossiliferous condition, all attempts to correlate it were futile. Below the shale horizon occurs the regularly bedded, hard, bluish Laurel limestone.

In view (b) the position of the Waldron shale is marked by the regular groove running across the picture from side to side. Above is the irregular, broken to massive limestone; below is the regularly bedded Laurel limestone.

Section of the lower end of the cliff, seen in view (a) Plate I, some 50 yards lower than the preceding section:

	Ft.	In.
1. Drift	2	..
2. Sandy limestone	2	6
3. Sandy limestone	5	..
4. Sandy limestone	2	6
5. Irregularly bedded, sandy limestone, very variable	2	8
6. Waldron shale, with small limestone nodules.....	..	1½
7. Laurel limestone, hard, bluish.....	..	8
8. Laurel limestone, hard, bluish.....	..	5
9. Laurel limestone, hard, bluish.....	..	2
10. Laurel limestone, hard, bluish.....	..	8
11. Laurel limestone, hard, bluish.....	..	5
12. Laurel limestone, hard, bluish.....	..	10
13. Hard, grayish to blue limestone.....	..	4
14. Hard, bluish Laurel limestone.....	1	..
15. Hard, bluish Laurel limestone.....	..	10
16. Hard, bluish Laurel limestone.....	..	10
17. Hard, bluish Laurel limestone.....	..	5
18. Hard, bluish Laurel limestone.....	1	..

	<i>Ft.</i>	<i>In.</i>
19. Hard, bluish Laurel limestone.....	..	4
20. Hard, bluish Laurel limestone.....	..	8
21. Bed of creek.....	0	..
	<hr/>	<hr/>
	23	4½

On the north side of the creek, opposite the cliff, where the foregoing sections were obtained, is located a limekiln owned by Mr. Rodman, of Milford. The stone quarried lies above the horizon of the Waldron shale. It is reported by the owner to be a good lime rock, making a fine quality of lime. The capacity of the kiln is 750 bushels. The lime is used to supply local trade.

Section of the south bank of Clifty Creek, at the bend in the stream at the northwest quarter of the northwest quarter of section 3, one-half mile southwest of Milford, and above the old Critser mill dam:

	<i>Ft.</i>	<i>In.</i>
1. Massive, sandy limestone.....	20	..
2. Light grayish limestone.....	..	2 to 6
3. Light grayish limestone.....	..	4
4. Light grayish limestone.....	..	2½
5. Light grayish limestone.....	..	4
6. Light grayish limestone.....	..	4
7. Hard, bluish limestone.....	..	6
8. Hard, bluish limestone.....	..	11
9. Hard, bluish limestone.....	..	10
10. Covered to the edge of water in the mill dam ..	..	4
	<hr/>	<hr/>
	24	3½

The foregoing section was run at the south end of the cliff, some 750 yards above the mill dam. As is seen in the section, the Waldron shale is here absent, but its position is probably marked by the light, grayish non-fossiliferous limestone Nos. 2 to 6, inclusive. The bedding plane between the overlying limestone and the thin grayish limestone is very irregular. The upper stratum of grayish limestone varies greatly in thickness. The strata form cliffs here and there at the sharp turns in the stream. The upper strata of sandy limestone form projecting ledges of some three or four feet. The cliff above the dam is probably 300 yards long and 25 to 35 feet high. The channel of the stream is post-glacial at this point, and as far as the bridge at Milford and farther. In the road above the cliff the Devonian is exposed, coming within a few feet of the level of the adjacent country. The drift is probably lighter here than at any other point in this vicinity.

Section of the west bank of Clifty Creek, 150 yards above the iron bridge in the northeast quarter of the northeast quarter of section 4, one and one-half miles southeast of Milford:

	<i>Ft.</i>	<i>In.</i>
1. Drift	8	..
2. Massive, sandy limestone.....	15	..
3. Light, hard, sandy limestone.....	6	..
4. Light grayish limestone.....	2 to 4	..
5. Sand and clay.....	0 to 2	..
6. Light grayish limestone.....	5	..
7. Light grayish limestone.....	4	..
8. Hard, grayish limestone.....	8	..
9. Hard, grayish limestone.....	10	..
10. Hard, grayish limestone.....	1	1
11. Hard, bluish limestone.....	2	5
12. Hard, bluish limestone.....	10	..
13. Hard, bluish limestone.....	5½	..
14. Hard, bluish limestone.....	6	..
15. Hard, bluish limestone.....	9	..
16. Hard, bluish limestone.....	10	..
17. Chert	1	..
18. Hard, blue limestone.....	10	..
19. Hard, blue limestone.....	3	..
20. Chert streak	1 to 2	..
21. Hard, blue limestone.....	2	..
22. Hard, blue limestone.....	6	..
23. Hard, blue limestone.....	1	8
24. Hard, blue limestone.....	6	..
25. Hard, blue limestone.....	4	..
26. Bed of creek.....	0	..
	87	7½

The correlation of the exposed strata at this point is, in part, questionable. The massive sandy limestone belongs to the Devonian, and the sand and clay and the grayish limestone is questionable. The hard, blue limestone is unquestionably the Laurel limestone. Some 50 yards up the creek the irregularly bedded, non-fossiliferous limestone, which may mark the horizon of the Waldron shale, weathers rapidly, forming a horizontal crevice along the cliff and leaving a residue of clayey, sandy dirt. If this limestone represents the Waldron shale, it has evidently become very calcareous, which is indicative of the fact that the shale is subjected to decided local variations, running from a fine shale to an impure limestone. This variation is seen at other points, and is to receive due notice farther on. At the east end of the bridge, on each side of the road, is an exposure, including the exposures at the

forks of the road, which has a probable thickness of 20 feet, of a very arenaceous limestone. A greater per cent. of this exposure is sand than that of any other examined in this county. The rock is soft, irregularly bedded and easily crushed.

A good exposure of the Waldron shale is found near a small spring east of Clifty Creek and north of the road, at the center of the south side of section 7, two miles west and north of Burney, where the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Thin, irregularly grayish, non-fossiliferous limestone, which is probably the Hartsville bed.....	3	..
2. Argillaceous shale	2	2
3. Calcareous shale	1	8
4. Laurel limestone in bed of branch.		

The shale runs from a clay shale at the top to a shaly limestone near the center, and then to a shale in the lower one-third. Few Waldron shale fossils were observed. Outcrops also occur near the center of section 18, two miles west of Burney.

The Waldron shale is exposed just south of the railroad bridge across the creek and to the east of the road. The total thickness of the shale at these places is not exposed. The exposed part, a clay shale, is one and one-half feet thick. The road running north along the creek follows the horizon of the shale for some 500 yards. The overlying limestone was exposed at only one place. Below the shale to the bed of the creek occurs the Laurel limestone, which forms the small cliff, with an average height of 12 feet, along the road side. Some of this stone has been quarried for bridge purposes. At a small stream 300 yards south of the railroad bridge the Waldron shale horizon is noticeable at the road side.

A section 200 yards west of the ford across Clifty Creek, in the southwest quarter of the southwest quarter of section 18, two and one-half miles southwest of Burney, is as follows:

	<i>Ft.</i>	<i>In.</i>
1. Covered	20	..
2. Arenaceous limestone	2	..
3. Waldron shale	1	1
	<hr/>	<hr/>
	23	1

This exposure is north of the road in a small ravine, and is 10 feet or more above the bed of Clifty Creek. The upper six inches of the exposure is a pure shale while the lower seven inches is more or less calcareous. This exposure is just over the county line in Bartholo-

mew County, but owing to its relation to the preceding sections, it was thought advisable to insert it in this connection.

As is seen in the foregoing sections, the shale along Clifty Creek in this county is subjected to great variation, both as to thickness and composition, running from a thickness of three or four feet to naught inches, and from a pure shale to argillaceous limestone. Overlying the shale is from two to seven feet of more or less irregularly thin bedded limestone of questionable age. This is due to its non-fossiliferous condition and a lack of characteristic lithologic features. Above this questionable limestone, which we are inclined to refer to the Upper Silurian, is some 8 to 15 feet of rather heavy massive, arenaceous limestone referable to the early part of the Devonian Age.

EXPOSURES ALONG BIG AND LITTLE FLAT ROCK CREEKS.

Along Little Flat Rock Creek, from the Rush County line to Downeyville, the exposures are not very plentiful; all observed belonging to the Niagara Group. Along the road beside the creek in section 3, two miles northeast of Downeyville, the Laurel limestone is exposed and contains a number of crinoid stems. A good point for the observation of the crinoid beds is just south of the center of section 3, on the south side of the creek and on the north side of the road. At Downeyville there are good exposures of the Laurel beds, and they are so located as to offer fairly good inducements for quarrying. At the gas well west of the creek, at this point, the drift was reported 80 feet thick.

It is quite probable that during glacial or pre-glacial times Little Flat Rock and Big Flat Rock creeks were united just above Downeyville. This is indicated by the narrow post-glacial valley of Little Flat Rock Creek at and below Downeyville, the narrow divide of drift at the forks of the road in the southeast quarter of the southeast quarter of section 6, one-fourth mile above Downeyville, and the wide flood plain of Big Flat Rock Creek at this place. Near the junction of these two streams below Downeyville there are a number of sand and gravel hills.

Below the gorge, west of Downeyville, is "Danta Hole," a rather large semi-circular body of water reported to be 12 to 20 feet deep. Above the hole is a rapid of three or four feet. The origin of this hole is due to the erosion of the water falling over the edge of the Laurel limestone. Quite a number of fabulous stories are current in the neighborhood as to the origin and depth of this "remarkable hole." "Danta Hole" suggests Douglas Hole, a like body of water with a

similar history, on Clifty Creek above Sandusky. The Devonian, if present along the creek at this place, is far back in the hills and covered by drift.

One mile and a half north of Downeyville, on Big Flat Rock Creek at Lemmon's quarry, the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Hard, grayish limestone.....	4	..
2. Grayish limestone, burns well into lime.....	8	..
3. Hard, blue limestone in regular courses of 2 to 8 inches	9	..
4. Rough ledge of hard, blue limestone, with two discontinuous chert layers.....	3	..
5. Hard, blue limestone.....	..	5
6. Hard, blue limestone (milk trough ledge).....	1	2
7. Hard, blue limestone.....	1	..
8. Hard, blue limestone (18-inch ledge).....	1	6
No. 8 has an iron streak 3 inches from the top.		
9. Hard, blue limestone to bottom of the quarry, which is about 11 inches above the bed of the creek	1	..
	29	1

The quarry is located on the south side of the creek, above the iron bridge. At this point the creek channel is very narrow, evidently post-glacial, while above and below this narrow channel of some 250 yards in length, the valley is much wider and is probably pre-glacial.

Across the creek from Lemmon's quarry is Hayes's quarry, where the same stone is quarried. In both of these quarries a dirt seam running from two to six inches was observed, and was reported by Mr. Lemmon as crossing the creek, he having observed it many times in the bed of the creek when the water was low. At the Goswell gas well, one-half mile north, Mr. Lemmon reports dirt, or drift, 260 feet thick below which was shale down to the Trenton limestone, which was struck at a depth of 900 feet, and he is of the opinion that this dirt seam continues north and was struck in this well. Whether this be true or not is impossible to say. He further states that he was present when the well was shot, and that quite a lot of fragmentary fossils were blown up, similar to the ones found on Conn's Creek below Waldron. Below is given a sketch of the dirt seam as seen in the Lemmon quarry:

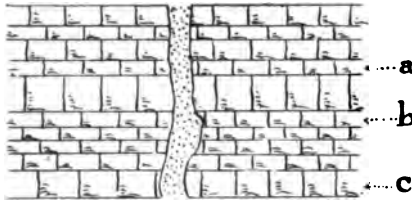


Fig. 3. Section showing dirt seam in the Lemmon quarry.

- (a)—Rough ledge.
- (b)—Milk trough ledge.
- (c)—18 inch ledge.

The following section was obtained at Garret's quarry a short distance below the Lemmon quarry:

	<i>Ft.</i>	<i>In.</i>
1. Drift	4	..
2. Hard, blue limestone.....	6	6
3. Hard, blue limestone.....	8	8
4. Hard, blue limestone.....	5	5
5. Hard, blue limestone.....	3½	3½
6. Hard, blue limestone.....	6½	6½
7. Hard, blue limestone (18-inch ledge).....	1	5½
8. Hard, blue limestone.....	4½	4½
9. Hard, blue limestone.....	8	8
10. Hard, blue limestone.....	4	4
11. Hard, blue limestone.....	1	2
	10	5

The rough ledge is found as boulders above the stone quarried at this quarry. All of the exposures at these quarries belong to the Niagara limestone.

Along the crooked branch through section 1, east of St. Omer, quite a lot of arenaceous limestone is exposed. Below the road, through the southeast quarter of the southeast quarter of section 4, this sandy limestone is found in the bed of the branch and continues for 400 yards outcropping in the bed and banks of the branch. This limestone is believed to be Devonian. Farther down in the bed of the branch the Laurel limestone outcrops. The Waldron shale is absent or covered.

Exposures in the vicinity of St. Paul, in this and Shelby counties.

Section of the H. C. Adams quarry on Big Flat Rock Creek, just east of St. Paul:

	<i>Ft.</i>	<i>In</i>
1. Chert and thin, irregularly bedded limestone (Laurel)	18	..
2. Hard, blue Laurel limestone.....	1	9
3. Hard, blue Laurel limestone.....	1	2
4. Hard, blue Laurel limestone.....	..	10
5. Hard, blue Laurel limestone.....	1	6
6. Hard, blue Laurel limestone.....	1	6
7. Hard, blue Laurel limestone.....	1	2
8. Hard, blue Laurel limestone.....	1	2
9. Hard, blue Laurel limestone.....	1	6
10. Hard, blue limestone (milk trough ledge).....	1	9
11. Hard, blue Laurel limestone.....	1	2
12. Hard, blue Laurel limestone.....	..	8
13. Hard, blue Laurel limestone.....	2	4
14. Hard, blue Laurel limestone.....	2	8
15. Hard, blue Laurel limestone.....	1	..
16. Hard, blue Laurel limestone.....	1	4
17. Hard, blue Laurel limestone.....	3	4
18. Hard, blue Laurel limestone.....	..	7
19. Soft, reddish Osgood limestone.....	1	9
20. Harder Osgood limestone (the green ledge).....	1	9
21. Soft Osgood limestone.....	1	..
22. Soft Osgood limestone.....	4	..
23. Osgood shale	3+	..
	<hr/>	
	54	11

The Osgood beds are not exposed; their thickness and texture were reported by quarrymen. Across the creek from the Adams quarry is another quarry, where exposures similar to those in the foregoing section occur.

Along the creek one-half mile above St. Paul, the Laurel limestone is quarried quite extensively. At this quarry and at the quarries at St. Paul what seems to be the upper courses of the Laurel limestone are exposed. Above these exposures, as far as observations showed, is drift. The line marking the supposed horizon of the Waldron shale at this point was located without observing either the shale or the Devonian. A reported section of a gas well in St. Paul fails to show the presence of the shale or Devonian.

Section of well—

	<i>Ft.</i>
1. Drift	28
2. Hard limestone (Laurel).....	40
3. Shale	700
4. Trenton	25
	<hr/>
	793

Gas was found at a depth of 14 feet in the Trenton.

Pressure, 225 pounds.

The reports obtained of different wells in St. Paul point to the conclusion that the Waldron shale and Devonian limestone are absent at this place, despite the fact that only a short distance below the town along Big Flat Rock Creek, and far below the level of the town, there occurs the heaviest deposit of the Waldron shale found anywhere in the county. This incongruity may be due to an error in the reported sections or the lack of a deposition of the shale at this particular place, or subsequent erosion after deposition. Below is given the section obtained at the Scranton quarries below St. Paul along the creek where the Waldron shale is exposed:

	<i>Ft.</i>	<i>In.</i>
1. Drift	5	..
2. Waldron shale	6	..
3. Hard, blue Laurel limestone.....	8	..
4. Hard, blue Laurel limestone.....	4	..
5. Hard, blue Laurel limestone.....	6	..
6. Hard, blue Laurel limestone.....	5	..
7. Hard, blue Laurel limestone.....	9	..
8. Hard, blue Laurel limestone.....	8	..
9. Hard, blue Laurel limestone.....	3	..
10. Hard, blue Laurel limestone.....	5	..
11. Hard, blue Laurel limestone.....	7	..
12. Hard, blue Laurel limestone.....	7	..
13. Hard, blue Laurel limestone.....	6	..
14. Hard, blue Laurel limestone.....	7	..
15. Hard, blue Laurel limestone.....	8	..
	17	11

The Waldron shale at this place has a drab to blue color, and is free from calcareous masses. The exposure occurs at the lowest of the three quarries. At the time of examination the quarries were not in operation, and were in the hands of a receiver. At the iron bridge, across the creek below the quarries, the Laurel limestone is exposed six feet or more above the bridge, and is overlain by drift. Following down the creek to Vickhart's flouring mills a number of good exposures of the Laurel limestone were observed; but the Waldron shale, if present, is covered.

WESTPORT AND VICINITY.

From the report given of the well at the Owen Hotel in Westport, the Devonian, presumably, underlies the town. Below is given the section as reported by the proprietor:

	<i>Ft.</i>
1. Drift	40
2. Soft, sandy limestone (Devonian).....	14+

No outcrops of this sandy limestone were observed east of the town along Cobb's Fork of Sand Creek. It probably thins out before reaching the creek. Along the creek were numerous exposures of the Laurel limestone and the Osgood beds, the latter occurring low in the hill. A good exposure of the Osgood beds is found along the roadside just west of the creek at the bridge one and one-half miles southeast of Westport. At the Westport limestone quarry, and at the Hollinsbe quarry, the following combined section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Clay and drift.....	3 to 4	..
2. Hard, blue, irregularly bedded Laurel limestone, the courses varying in thickness from 3 to 23 inches.....	16	7
3. Osgood limestone and shale.....	10+	..
	<hr/>	<hr/>
	30	7

One stratum of the Osgood limestone, three feet two inches thick, was reported as an excellent stone for building purposes. The Laurel limestone is quarried quite extensively at these quarries.*

One and a half miles east of Westport, at the McGee quarry, typical exposures of the Laurel limestone are found. Here quarrying is carried on quite extensively, notwithstanding there is no railroad connection. The stone is of a good quality, with desirable and variable thickness, and similar to the stone quarried southeast of Westport. Overlying the thin, irregularly bedded and cherty limestone, marking the top of the Laurel beds, is a light deposit of drift and clay. The Devonian does not outcrop, and if it extends east to the creek, it lies high in the hills drift covered. On this supposition, the line marking its eastern extension at this place was located on the accompanying map. One mile west of Westport the Devonian outcrops along Wyalusing Creek. The following section was taken of the eastern bank of the creek above the bridge:

	<i>Ft.</i>	<i>In.</i>
1. Drift	6	..
2. Massive, hard, light to dark-colored arenaceous limestone	8	..
3. Hard, dark-colored, irregularly bedded limestone..	..	6
	<hr/>	<hr/>
	14	6

* For fuller report see the 22d Annual Report of this Department.

At the Cora quarry, recently opened, along the creek one-fourth mile above the bridge, the following section was obtained:

- Ft.
1. Soft, sandy, light-colored, irregularly bedded Devonian limestone, courses running from 6 to 24 inches to bed of creek 8

This stone is quarried for road use and is reported as an excellent stone for this purpose.

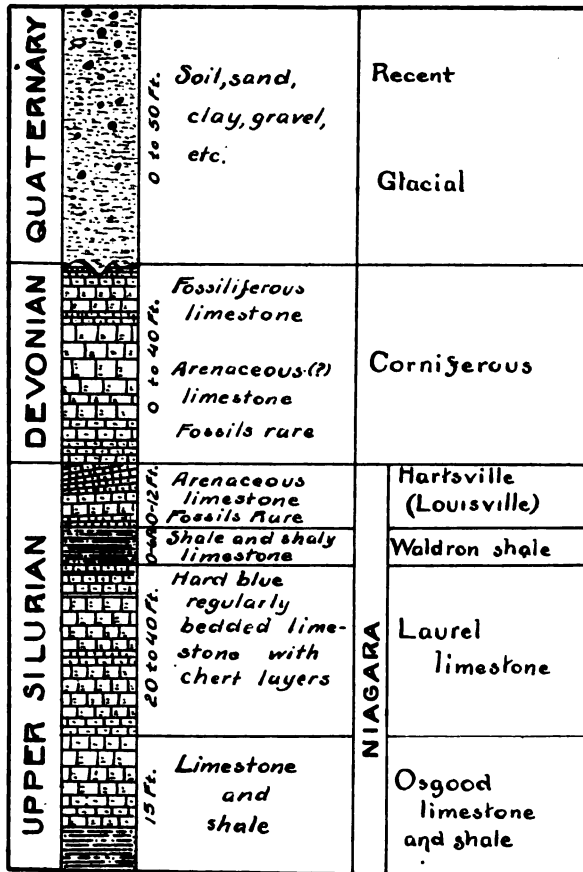


Fig. 4. Columnar section of the rocks of that part of Decatur County included in this report.

Near a small spring, south of the road, near the center of section 25, one and one-half miles northwest of Westport, is an outcrop of four feet of irregularly bedded limestone. Above the spring where the branch crosses the road is an exposure of hard, sandy limestone.

At the Cain quarry, in the northwest quarter of the same section, some six feet of hard, slightly arenaceous, irregularly bedded, non-fossiliferous limestone, which is quarried for road use, outcrops; the same stone as outcrops at the Cora quarry in section 36.

The topography of this region runs from level and slightly dissected areas to a rough broken country along the largest streams. To the north and northwest of Westport, in the vicinity of Waynesburg, the country is nearly level with few meandering post-glacial stream valleys. The drift runs from 12 to 50 feet in thickness.

Three and a half miles northeast of Westport, in section 20, is a monument, reported as 18 feet high, which marks the center of population for the United States in 1890.

The section ends with the Osgood shale. Underlying this shale is the lower Osgood limestone, and beneath this is the Clinton limestone. The last two formations were not observed, but it is quite likely that in the eastern part of the area mapped, along Sand Creek, they may occur, especially the Lower Osgood limestone. No careful examination was made for them.

BARTHOLOMEW COUNTY.

Geographic—Bartholomew County lies west of Decatur County, and is bounded on the south by Jennings and Jackson counties, on the west by Jackson and Brown counties, and on the north by Johnson and Shelby counties. Only about 36 square miles in the northeast corner of the county are covered by this report; the strip being four miles wide from east to west, and nine miles long north and south. Hartsville and Newburn are the only villages in the territory mapped, Hartsville lying near the east side, east and west, and near the center north and south. The entire area mapped is included in the glaciated portion of the county. The deposits are not strewn over the surface regularly, but in some cases are 30 or 50 feet deep, though elsewhere there may be no more than a mere veneer of boulder clay. Indeed, at quite a number of places, especially along the streams, the surface is bare rock.

DRAINAGE AND TOPOGRAPHY.

The south half of the territory is drained by Clifty Creek, which crosses the area from northeast to southwest, passing by Hartsville and Newburn. The north half is drained by Flat Branch, Duck Creek, and Little Haw Creek. The topography runs from level plains, crossed by post-glacial valleys, to more or less irregularly broken lands along

Clifty Creek, where the hills may rise 50 or 60 feet above the creek valley.

With reference to the surface geology and glaciation, the following extract is taken from Frank Leverett's Water Supply and Irrigation Papers of the United States Geological Survey:

"The entire county was apparently glaciated, although the glacial boundary lies but little west from the front of the prominent hills on the county line. The portion of the county east from the East White River valley was nearly all covered by the later ice, and a narrow belt along the west side of the stream in the north part of the county was also covered by that invasion. There remains, therefore, only a narrow strip on the southern and western borders of the county where the older sheet of the drift alone is present. There are morainic features along the borders of the east White River valley from the north line of the county southward to the vicinity of Columbus. There are also two well defined moraines eastward and northeastward from this valley across the country. The southernmost one, which lies near the line of Bartholomew and Jennings counties, marks the southern limit of the later Wisconsin sheet of drift. The other lies near the borders of Clifty Creek. Each of these moraines has a breadth of two or three miles, but stand only 30 or 40 feet above the bordering plain.

"The surface of the older drift in this county is generally plane. The thickness of the drift ranges from a mere trace to a deposit fully 100 feet in depth. Along the east White River valley there is a gravelly belt from two to five miles or more in width, and the morainic knolls just referred to appear in the midst of this gravelly district. Flat Rock valley also contains a broad gravel plain. In the remainder of the county the drift is mainly till. Very few deep wells occur, there being generally an abundant water supply within 35 or 40 feet of the surface."

DISTRIBUTION OF THE WALDRON SHALE.

Nearly all of the outcropping rocks in this territory belong to the Devonian Age. Along Clifty Creek and some of its largest tributaries the Upper Silurian rocks are exposed, the parting line between the two formations running from 10 to 25 feet above the creek beds. Above the Waldron shale there are four or five feet of non-fossiliferous limestone which corresponds lithologically to what was correlated farther north as the Hartsville bed. This division, which, as stated above, corresponds to Foerste's Louisville, is very indistinct, the gradation between it and the overlying arenaceous limestone being so gradual that it is impossible to say just where one quits off and the other begins.

However, it is believed that a few feet of the limestone overlying the shale belongs to the Niagara. This formation forms the upper and hard ledges at the top of Anderson and Long's falls, south of Hartsville.

It has been stated that the Waldron shale forms the top of the Niagara. At this point, however, there is naught to eight or more feet of Upper Silurian limestone overlying the shale. To fully settle this question of correlation a great deal of time and paleontological research are necessary, and an interesting problem here exists for the paleontologist well versed in Devonian and Upper Silurian fauna.

Two and a half miles southwest of Burney the Waldron shale is exposed 200 yards east of the ford across Clifty Creek. (See section on page 104.)

A section of the west bank of Clifty Creek, 650 yards below the ford mentioned in the preceding section, and in the southeast quarter of the southeast quarter of section 24, three miles north of Hartsville, is as follows:

	<i>Ft.</i>	<i>In.</i>
1. Covered to top of hill.....	20	..
2. Sandy limestone	5	..
3. Covered and apparently the horizon of the Waldron shale	2	..
4. Thin, irregularly bedded limestone, which probably represent the calcareous base of the Waldron shale .....	..	5
5. Hard, blue Laurel limestone.....	..	11
6. Hard, blue Laurel limestone.....	2	11
7. Hard, blue Laurel limestone.....	..	10
8. Hard, blue Laurel limestone.....	..	9
9. Covered to bed of creek.....	1	6
	34	4

At the large spring, one-fourth mile down the creek and above the old mill dam, the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Arenaceous limestone	2	..
2. Covered	8	..
3. Irregularly bedded limestone.....	1	6
4. Hard, blue Laurel limestone.....	1	7
5. Hard, blue Laurel limestone.....	..	4½
6. Hard, blue Laurel limestone.....	1	..
7. Hard, blue Laurel limestone.....	1	10
8. Hard, blue Laurel limestone.....	1	2
9. Hard, blue Laurel limestone.....	..	9
	18	2½

The arenaceous limestone in No. 1 belongs to the Devonian, and the Waldron shale, if present, is covered. Above the spring, to the turn of the creek, the sandy ledge forms a small cliff with a thickness of 8 to 12 feet. Beyond the turn of the creek, and below the last of the foregoing sections but one, the Waldron shale was poorly exposed and mixed with gravel, soil, etc.

Across the creek from the spring, and in the southeast quarter of the southeast quarter of section 24, two and a half miles above Harts-ville, the following strata were exposed in a small ravine:

	<i>Ft.</i>	<i>In.</i>
1. Massive, sandy limestone.....	6	6
2. Hard, sandy limestone.....	3+	..
3. Covered	1	6?
4. Thin, irregularly bedded limestone that may repre- sent the base of the Waldron shale.....		6
5. Hard, blue Laurel limestone.....		4
6. Hard, blue Laurel limestone.....		5
7. Hard, blue Laurel limestone.....		4
8. Hard, blue Laurel limestone.....		3
9. Hard, blue Laurel limestone.....		2
10. Hard, blue Laurel limestone.....		6
11. Hard, blue Laurel limestone.....		9
12. Hard, blue Laurel limestone.....		7
13. Hard, blue Laurel limestone.....		4½
14. Hard, blue Laurel limestone.....	1	..
15. Hard, blue Laurel limestone.....		5
16. Hard, blue Laurel limestone.....		6
17. Covered		3½
18. Water in old mill dam.....	0	..
	17	8

If the Waldron shale occurs here at all it is very thin. No. 2 in the above section probably belongs to the Devonian. We are inclined to believe that the shale is absent at this place, probably having been removed after its deposition. However, at no point was the sandy limestone observed resting directly upon the Laurel limestone. The covered space was only a few feet, but enough to conceal a thin stratum of shale. The massive sandy limestone breaks down in large pieces, together with soil, boulders, and other debris, and covers the shale horizon. The road seems to run in general not far from the top of the Laurel limestone.

Down the creek at the center of the south side of section 24, and two miles above Hartsville, where the road through section 25 joins the creek road, the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Sandy limestone	8+	..
2. Covered	7	..
3. Shale to argillaceous shale.....	2+	..
4. Covered	1	6
5. Light, grayish, irregularly bedded limestone.....	..	10
6. Laurel limestone	5	..
7. Covered to creek.....	7	..
	31	4

Just above the Waldron shale three or four sandy limestone boulders are exposed. No. 5 probably represents the base of the shale. Along the creek road, above the forks of the road where the foregoing section was taken, the sandy limestone is exposed at a number of places—soft, massive, and arenaceous.

Close observation failed to reveal the Waldron shale along Hiner Branch, one mile north of Hartsville, although high in the hills were heavy exposures of the sandy limestone, and near the branch the Laurel limestone was exposed. The horizon of the shale was covered. The exposures were followed up the branch until the Devonian formed the bed of the creek. At one place, where a farm road crosses the branch and climbs the south bank, the Devonian limestone is very sandy; almost a pure sandstone.* Here it resembles very closely the exposures referred to above at the east end of the bridge across Clifty Creek, in section 4, one and one-half miles north of Burney.

From the mouth of Hiner Branch to the bridge across Clifty Creek, north of Hartsville, the horizon of the Waldron shale follows along just above the creek road at most places, some 15 to 20 feet above the creek. About half way down to the bridge from the mouth of Hiner Branch the Waldron shale is poorly exposed along the roadside. The exposure is argillaceous, mixed with soil. Only a few inches are exposed. Below the shale horizon down to the bed of the creek the regular bedded Laurel limestone is exposed. Two hundred and fifty yards below the bridge, and on the west side of the creek, the following section was obtained:

* See report on Niagara Limestone in the Twenty-Second Annual Report of this Department.

	<i>Ft.</i>
1. Drift	10
2. Massive, arenaceous limestone.....	12
3. Covered (Waldron shale horizon).....	6
4. Thin, irregularly bedded limestone.....	1
5. Hard, bluish to grayish limestone.....	9
6. Bed of creek.....	0
	38

The sandy limestone forms a small cliff, which runs along the hillside at places increasing in thickness to a maximum thickness of 18 feet. The regularly bedded limestone near the bed of the creek is the Laurel limestone, and the sandy limestone near the top of the hill belongs to the Devonian Age. The Hartsville bed and the Waldron shale, if present, are not exposed.

HARTSVILLE AND VICINITY.

West of Hartsville, along the creek on the west side, good exposures of the Devonian limestone are found; lower and nearer the bed of the creek, especially at the ford bridge, occur good exposures of Laurel limestone. East of the creek, along the road leading to the southwest from Hartsville, and just outside of the town limits, occur typical exposures of the Laurel beds. At one point on the west side of the creek, not far northeast of the old limekiln, a few inches of Waldron shale were noted.

At the old stone quarry on the east side of the creek, one-fourth mile below Hartsville, the Waldron shale is exposed. The following section was obtained at this exposure:

	<i>Ft.</i>	<i>In.</i>
1. Drift	2 to 4	..
2. Waldron shale	5	3
3. Hard, blue to gray limestone.....	1	3
4. Hard, blue to gray limestone.....	1	10
5. Hard, blue to gray limestone.....	..	6
	12	10

The Waldron shale is exposed above the exposed rock strata in the quarry, and is, with the exception of the bottom 15 inches, a pure shale. The bottom 15 inches consist largely of irregularly bedded to shelly limestone, forming what seems to be the transition between the shale and underlying limestone.

Section of the Laurel limestone exposures at the west end of the foot bridge across Clifty Creek, one-fourth mile below Hartsville:

	<i>Ft.</i>	<i>In.</i>
1. Hard, blue Laurel limestone.....	3	..
2. Hard, blue Laurel limestone.....	1	2
3. Hard, blue Laurel limestone.....	2	2
4. Hard, blue Laurel limestone.....	1	10
5. Hard, blue Laurel limestone.....	..	10
6. Hard, blue Laurel limestone.....	1	7
7. Hard, blue Laurel limestone.....	1	6
8. Hard, blue Laurel limestone.....	..	4
9. Hard, blue Laurel limestone.....	..	8
10. Hard, blue Laurel limestone.....	..	7
11. Hard, blue Laurel limestone.....	..	10
12. Covered	1	..
	<hr/>	<hr/>
	15	6

The top of this section reaches up to the road and apparently to the top of the Laurel limestone. The Waldron shale is not exposed at this place, but only a few yards down the creek and on the same side of the stream, at the small Dietrich quarry the shale is exposed. The following section was taken at the quarry:

	<i>Ft.</i>	<i>In.</i>
1. Soil	2	..
2. Argillaceous shale to pure shale.....	1	6
3. Hard, blue Laurel limestone.....	..	4
4. Hard, blue Laurel limestone.....	..	2
5. Hard, blue Laurel limestone.....	..	5
6. Hard, blue Laurel limestone.....	..	6
7. Hard, blue Laurel limestone.....	..	6
8. Hard, blue Laurel limestone.....	..	9
9. Hard, blue Laurel limestone.....	..	8
10. Hard, blue Laurel limestone.....	..	10
11. Hard, blue Laurel limestone.....	..	2
12. Hard, blue Laurel limestone.....	..	7
13. Hard, blue Laurel limestone.....	..	6
14. Hard, blue Laurel limestone.....	..	6
15. Hard, blue Laurel limestone.....	..	6
16. Hard, blue Laurel limestone.....	..	6
	<hr/>	<hr/>
	10	5

The high-water mark of Clifty Creek is three feet below the Waldron shale in the foregoing section.

Across the creek from the Dietrich quarry, at the turn in the road, occurs an exposure of the shale. Only a few inches are exposed. The shale at this, and other close exposures, seems to be non-fossiliferous.

At the head of a small ravine near Mr. Yelley's house, on the south side of the creek, in the northeast quarter of the northeast quarter of section 2, one-half mile below Hartsville, the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Irregularly bedded sandy limestone of questionable age	5	6
2. Shale and shaly limestone.....	2+	..
3. Covered	4	..
4. Laurel limestone to bed of creek.....	15	?
	26	6

Just west of the exposure, the massive sandy limestone comes down to what seems to be the horizon of the Waldron shale. The strata immediately over the shale in the ravine form the top of a small waterfall. Following down the creek to the mouth of Falls Fork, the Waldron shale was observed at the head of two ravines; one near the south side of the northeast quarter of the northeast quarter of section 12, where the shale was one and one-half feet plus; the other, 250 yards above the mouth of Falls Fork, where the shale was four and one-half feet thick.

Two hundred yards southeast of the bridge across Falls Fork Creek, near its mouth, is a good exposure of the shale. It occurs in deep gullies, where it is probably four or five feet thick and is very fossiliferous, especially the lower half. This is an excellent place to gather Waldron shale fossils.

Across the bridge east of the road is an old "digging," where Waldron shale fossils were obtained years ago. At present the shale is covered. The following section was obtained at this place:

	<i>Ft.</i>	<i>In.</i>
1. Drift	20 to 30	..
2. Sandy limestone	2	6
3. Hard, bedded limestone.....	3	..
4. Covered (horizon or shale).....	4?	..
5. Covered to creek.....	20?	..
	59	6

Following down the creek on the south side to Turn Hole, the shale was observed outcropping in the meadow below the bridge. At Turn Hole, one-half mile below the bridge, the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Bedded, hard limestone.....	2+	..
2. Clay shale, poorly exposed, fossiliferous.....	3?	..
3. Regularly bedded Laurel limestone to creek..	15 or 18	..
	<hr/>	<hr/>
	23	..

The lower six inches of the Waldron shale are very calcareous. Usually the lower six or eight inches of the shale is calcareous, and often contains an abundance of fossils. As has been previously stated, this shaly to pure limestone marks the transition from the Waldron shale as a shale to the Laurel limestone.

The shale is also exposed at Tarr Hole, only a short distance from Turn Hole. At the latter place the Laurel beds form a perpendicular cliff some 15 feet high. The massive, sandy limestone exposed along the creek, west of Hartsville, and a number of other places, is not exposed at this place. It seems as though the sandy strata have lost their arenaceous character and occur as hard, thin bedded limestone.

A section of the northwest bank of Clifty Creek, one mile northwest of Newbern, in the northeast quarter of section 10, is as follows:

	<i>Ft.</i>	<i>In.</i>
1. Light, rather soft, sandy limestone.....	3	6
2. Hard, blue Laurel limestone.....	..	2 to 4
3. Hard, blue Laurel limestone.....	..	1 to 5
4. Regularly bedded, Laurel limestone, with courses 2 to 6 inches.....	3	..
	<hr/>	<hr/>
	7	3

The Waldron shale is absent, and it is believed that the sandy limestone in No. 1 belongs above the shale, and the lower beds are unquestionably Laurel limestone. There is what seems to be a slight unconformity between Nos. 1 and 2. This helps to explain the non-occurrence of the shale at this place.

A section of the north bank of the creek, 200 yards above the place indicated in the foregoing section, is as follows:

	<i>Ft.</i>	<i>In.</i>
1. Soft, massive (?) sandy limestone.....	2	..
2. Hard, irregularly bedded limestone of questionable age		0 to 6
3. Laurel limestone		3
4. Laurel limestone		4
5. Laurel limestone		1½
6. Laurel limestone		3
7. Laurel limestone		2
8. Laurel limestone		1½
9. Laurel limestone		3
10. Laurel limestone		2
11. Laurel limestone		1½
12. Laurel limestone		4
13. Laurel limestone		3½
14. Laurel limestone		3½
15. Laurel limestone		3½
16. Laurel limestone		6
17. Laurel limestone		6
18. Laurel limestone		7
Water's edge	0	..
	7	1

The shale has probably been removed at this place, as the Devonian seems to rest unconformably upon the Laurel limestone. A slight unconformity occurs between Nos. 2 and 3.

At a sharp turn in the creek in the northwest quarter of section 10, three-fourths miles above Newbern, some 10 feet of sandy limestone is exposed running down to the water's edge. At the time of examination the creek was slightly swollen, and probably during low water the Laurel limestone might be exposed, but judging from the dip of the strata above this place the assumption is that the line marking the horizon of the shale has passed below drainage. The sandy limestone at this place is the typical sandy limestone, weathering into a rough, irregular surface.

On the south side of the creek, one-half mile above Newbern, there are some 20 feet of sandy, massive limestone exposed running down to the water's edge. This sandy limestone runs into a grayish to blue irregularly thin bedded limestone above. The Waldron shale horizon is below drainage.

Under the south end of the bridge, across the creek at Newbern, eight feet plus of sandy limestone is exposed. This runs down to the bed of the creek. Higher in the hill the limestone is not so arenaceous.

The exposures were examined along the creek below Newbern for

two miles, and found to be Devonian. Above the bridge, two miles below Newbern, there occurs in the bed of the creek a good exposure of the sandy limestone.

South of Hartsville, on Boner Branch, between the old college campus and the cemetery, and between the wagon bridge and foot bridge, occurs a small waterfall, where the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Sandy limestone, the lower ledge of which forms the top of the falls.....	6	..
2. Hard, poorly bedded limestone which breaks down in irregular sharp-cornered pieces.....	3	7
3. Sandy clay, poorly exposed.....	..	6+
4. Covered	2?	..
5. Laurel limestone	4	6
	<hr/>	<hr/>
	16	7

No. 2 weathers faster than the overlying sandy limestone, which forms an overhanging rock at places. The correlation of this limestone (No. 2) is questionable, and, owing to the scarcity of fossils, is practically impossible with the passing examination that was given it. However, from the brief examination I am inclined to consider this as the stratigraphic equivalent of the Hartsville bed found at Long's Falls and Anderson Falls, and at places along Clifty creek. No. 3, in the foregoing section, probably marks the horizon of the Waldron shale, although the exposure was only observed at the one place, i. e., at the base of the falls. The exposure was such that it was impossible to say definitely that it was modified shale. Its arenaceous character seemed to be due to the disintegration of the sandy limestone. Two or three feet lower, and immediately under the foot-bridge, occurs an outcrop of Laurel limestone, regularly bedded with courses running from one to eight inches in thickness. The sandy limestone, with its rounded knolls and corresponding pockets, is found exposed at a number of places along this branch. Below this place, where the road leading south from Hartsville crosses the branch, the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Covered	9	..
2. Limestone and chert.....	4	6
3. Light-colored limestone	1	..
4. Covered	8	..
5. Poorly exposed, sandy limestone.....	15	..
	<hr/>	<hr/>
	37	6

The horizon of the Waldron shale is probably marked by No. 3. The shale, as a shale, seems to be absent at this place. The lower limestone belongs to the Laurel beds. Between this point and the college campus but very few exposures are found, making it impossible to trace the horizon of the shale by actual observation.

A section at Long's Falls, on Middle Fork, one and one-half miles south of Hartsville, was as follows:

	<i>Ft.</i>	<i>In.</i>
1. Slightly arenaceous limestone as seen above and on the north side of the falls.....	4	10
2. Hard, irregularly bedded, blue to grayish limestone	4	6
3. Waldron shale	2	3
4. Calcareous shale to light shelly limestone.....	..	4
5. Laurel limestone in bed of creek.....	0	..
	7	11

No. 1 belongs to the Devonian limestone, and No. 2 is questionable, but probably belongs to the Niagara. This limestone (No. 2) forms the top of the falls, and measures three feet in thickness. There is an excellent exposure of the shale at the base of the falls. The upper three to five inches is a clay shale; two to six inches lower the shale runs from a pure shale to a shaly limestone. Below the falls on each side of the stream the shale is exposed for some 200 or 300 yards, the exposure being best on the south side of the creek. Below the falls, some 350 yards, the Laurel limestone is exposed in the bed of the creek, where some quarrying has been done. The quarried stone is used principally for building purposes. Below this exposure, down to the mouth of the stream, but few exposures are found. The bed of the stream is of loose boulders, sand and clay. South of the school-house, at the forks of the road, the flood plain of the stream is very broad and continues so to the west side of the section, only a small ridge separating it from the narrow channel of Falls Fork.

In the accompanying view of Long's Falls, Plate II, the 10 inches of arenaceous Devonian limestone is not shown, it lying to the left and above the exposures as here revealed. The irregularly bedded limestone as seen over the shale is the questionable formation at this place. The smooth surfaced stone in the foreground is the Laurel limestone, and lies in the bed of the creek, which was dry at the time of examination.

The falls are interesting from another standpoint, showing as they do the necessary rock structure for the formation of one class of falls.

The overlying limestone which forms the crest of the falls, weathers much slower than the soft underlying shale. As the shale falls down and is removed by the moving water, the overlying limestone forms projecting ledges, which in the course of time, due to their own weight, break down in rather large irregular masses, two of which are seen near the center of the picture, and in this way the recession of the falls is brought about.

Only a short distance below the junction of Middle Fork and Falls Fork, at the east end of the foot bridge, in the northeast quarter of the northeast quarter of section 11, the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Rather massive, arenaceous limestone.....	5	6
2. Hard, grayish, irregularly bedded limestone.....	3	6
3. Shale and clayey shale.....	4	..
4. Regularly bedded Laurel limestone.....	8	..
	<hr/>	<hr/>
	21	..

No. 1 belongs to the Devonian and Nos. 2, 3, and 4 to the Niagara.

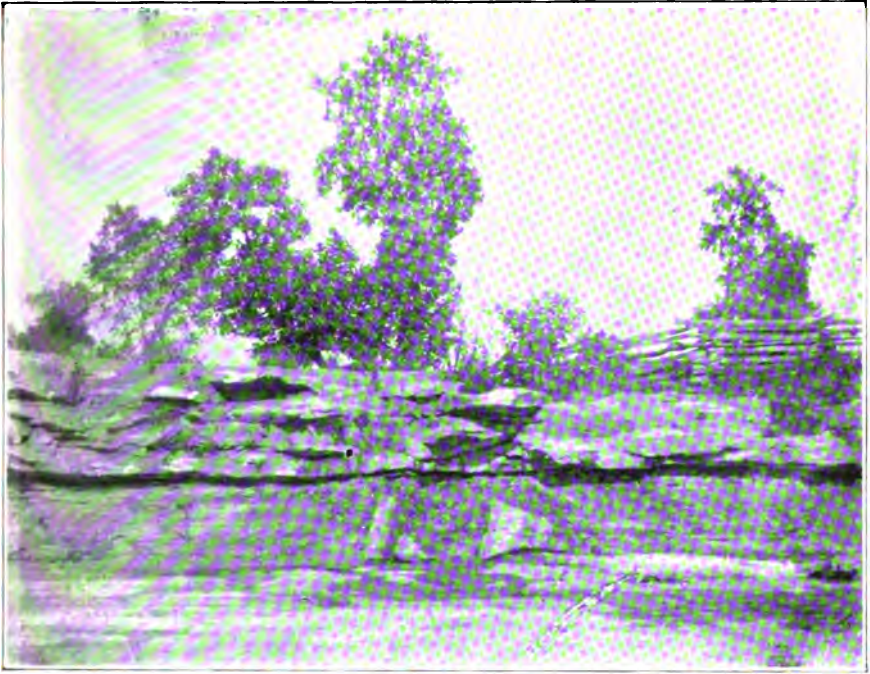
Just north of the foot bridge, at the sharp turn in the creek, a slight unconformity exists between the Devonian and the underlying Silurian limestone. The Waldron shale is about three feet thick at this place.

Only a short distance below the foot bridge, mentioned above, between the road and the creek, the following section was obtained along a short ravine:

	<i>Ft.</i>	<i>In.</i>
1. Drift	15	..
2. Arenaceous limestone	10	..
3. Hard, rather massive and slightly arenaceous limestone	3	6
4. Waldron shale	3	4+
5. Covered	2	..
6. Laurel limestone to bed of creek.....	10	..
	<hr/>	<hr/>
	43	10

Good exposures are found at a number of places along this creek, making the location of the Waldron shale horizon comparatively an easy matter.

In the northeast quarter of the southwest quarter of section 12, two miles south of Hartsville on Falls Creek, occurs Anderson Falls. These falls are higher than Long's Falls, but are formed by the same formations, which are thicker at this place. Above the falls for some 500



(a) View of Long's Falls on Middle Fork, 1½ miles south of Hartsville, Indiana.



(b) View of Anderson Falls on Falls Fork, two miles south of Hartsville, Indiana, showing the Hartsville limestone and the underlying Waldron shale. In the right-hand corner in the foreground lies a large limestone boulder, which has fallen down from the cliff to the right.

yards good exposures occur along the creek reaching up to the foot bridge near the south side of the section. Below is given a combined section of the exposures above and at the falls:

	<i>Ft.</i>	<i>In.</i>
1. Rather soft, arenaceous limestone.....	4	..
2. Hard, arenaceous limestone, with poorly marked bedding planes	9	6
(This reaches down to the top of the falls.)		
3. Hard, non-fossiliferous limestone, corresponding to the Hartsville ledge.....	4	11
(This stratum forms the top of the falls.)		
4. Limestone	1	4
5. Hard to shaly limestone.....	1	1
6. Coarse, drab to fine shale.....	3	..
7. Shale to shaly limestone.....	..	10
8. Shale	1	2+
	25	10

Edge of water in the pot hole below the falls.

It is believed that the heavy, and rather massive arenaceous limestone above the falls along the creek belongs to the Devonian Age, and that the limestone forming the crest of the falls belongs to the Silurian Age. The formations seem to be non-fossiliferous. At this, and other places, where formations have been given in this report as non-fossiliferous, it is to be understood that they were so reported judging from a hasty examination, and it is indeed quite probable that close and extended examination would reveal the presence of fossils, but since this report was to deal principally with the mapping of the territory, this finer paleontological work was left for the paleontologist.

It is quite probable that in the above section very few inches less than the total thickness of the shale is revealed; that part below the water's edge probably not running over three or four inches in thickness. Below the center of the shale occur a few rather heavy masses of limestone running to a shale through a shaly limestone at their edges. These masses stand out as a projecting ledge here and there in the stratum of shale. In the accompanying picture of the falls (see Plate II) they are seen near the water's edge to the left. To the right of the falls the Hartsville and Devonian limestone form quite a precipitous cliff with a maximum height of 20 feet. The shale is exposed for a short distance below the falls on each side of the creek. The fact that these falls are higher than Long's Falls is due to two things, viz., to an increased thickness in the Waldron shale, and to a greater volume of water carried by the stream.

North of Rugby, along Duck Creek, the arenaceous Devonian limestone is exposed in the bed of the creek. A good exposure was observed above the bridge just north of the village. To the west along Big and Little Haw creeks the drift is rather heavy and no exposure of country rock is shown.

At Hope the drift was reported running from 7 to 30 feet. An exposure of Devonian limestone was observed east of Duck Creek, along a small ravine just north of the road along the south side of section 28, two and a half miles northeast of Hope. From well sections reported through the county south of Hope and east to Clifty Creek, it seems more than probable that all of this territory is underlain with the Devonian limestone.

SHELBY COUNTY.

This county lies north of Bartholomew and Decatur counties, east of Johnson and Marion counties, south of Hancock County, and west of Rush and Decatur counties. Shelbyville, the county seat, is located centrally in the county.

Only a small portion of the county is covered in this report. The area mapped lies in the southeast corner of the county, and includes all of the civil township of Noble, and parts of Washington, Addison and Liberty townships.

The territory is drained by Big Flat Rock Creek, Conn's Creek, Bear Creek, and a few other smaller streams. The general direction of the drainage is to the southwest. The topography runs from slightly undulating till plains to a somewhat broken country along the largest streams.

This section of the country lies wholly within the glaciated portion of the State, and is covered with a drift coating, mainly till, running from only a few feet to 80 or more feet in thickness.

The following section of a well at Waldron is taken from the eleventh report of this Department:

	<i>Ft.</i>
1. Yellow till	10
2. Sand and gravel.....	14
3. Gray till	28
4. Sand	1
5. Rock, thought to be sandstone (probably the arenaceous limestone of this report).....	3

At St. Paul, on the boundary line between this and Decatur County, the drift varies from 10 to 90 feet.

Waldron lies near the center of the east half of the territory mapped.

DISTRIBUTION OF THE WALDRON SHALE.

VICINITY OF WALDRON AND SOUTH TO GENEVA.

The first examinations that were made in this vicinity were along Conn's Creek, one mile below Waldron, at the famous Waldron shale fossil beds. So much has already been written about these beds and the fossils, that we feel that this part of the territory can be dismissed with brief descriptions.

Going one mile south from Waldron and then 600 yards west, the bridge across Conn's Creek is reached, where the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Covered	1	..
2. Light grayish, rather soft and slightly arenaceous limestone		6
3. Light grayish, arenaceous limestone.....		5
4. Light grayish, arenaceous limestone.....		8
5. Rather hard, reddish limestone.....		5
6. Rather hard, reddish limestone.....		4½
7. Light grayish, arenaceous limestone.....		6
8. Light grayish, arenaceous limestone.....		2
9. Reddish, arenaceous limestone.....		6
10. Reddish, arenaceous limestone.....		10
11. Hard, grayish to bluish limestone, thin bedded....	6	..
	11	4½

Nos. 2 to 10, inclusive, belong to the Devonian Age, and No. 11 to the Silurian Age. This last mentioned division corresponds to the stone quarried in the Avery quarry, and is the Hartsville bed. This section was run 150 yards above the bridge, and on the east side of the creek. Only a short way below the bridge on the east side of the creek some little stone has been quarried. The stone quarried is the Hartsville bed. The base of the quarry is formed by the Waldron shale, which is here near the level of the creek bed. Only a short distance farther down the creek, and just above the mouth of Bear Creek, is the Avery quarry. Here quarrying is carried on quite extensively for local purposes. At the quarry the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Drift	5	..
2. Arenaceous limestone	2	..
3. Discontinuous shale and clay bands.....		0 to 1½
4. Thin, irregular beds of shaly limestone.....		11
5. Hard, gray to bluish limestone.....		9
6. Hard limestone, running from a gray to a blue from top to bottom.....	10	
7. Grayish limestone		3
8. Grayish limestone		7½
9. Grayish limestone		8½
10. Gray to blue limestone.....	1	..
11. Gray to blue limestone.....		4½
12. Gray to blue limestone.....	1	3½
13. Gray to blue limestone.....		11
14. Gray to blue limestone.....		7
15. Gray to blue limestone.....		5
16. Gray to blue limestone.....		8
17. Gray to blue limestone.....	1	1
18. Gray to blue limestone.....		4
19. Bottom of the quarry, which is formed by the Wadron shale, reported by quarrymen to be five feet thick.		
	17	10½

The following correlation seems to be the correct one for the exposed strata:

No. 2 belongs to Devonian, Nos. 3 to 18, inclusive, to the Silurian, forming the total thickness of the Hartsville bed. An unconformity exists between the Silurian formation and the overlying Devonian. This unconformity is seen best in the northeast corner of the quarry. Below in Figure 5 this unconformity, together with overlying and underlying formations, is shown.

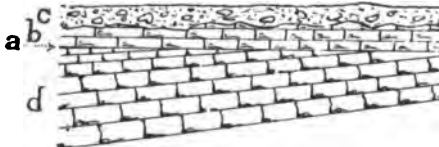
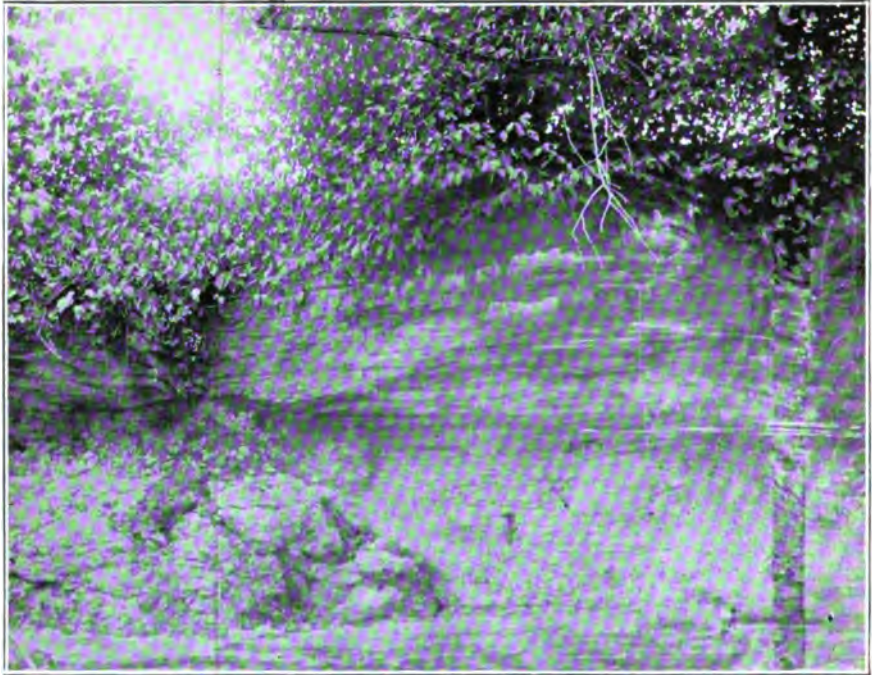


Fig. 5. Sketch of the north astend of the Avery quarry on Conn's Creek, one and a half miles below Waldron, Indiana.

- a—Line of unconformity.
- b—Devonian limestone.
- c—Drift. d—Hartsville limestone.

The rocks below the line of unconformity have a decided dip to the northwest. The total thickness of the limestone in the southeast corner of the quarry is five feet, and in the northeast corner 9 feet.



(a) View of the Waldron shale and overlying limestone, two hundred yards below the famous Waldron shale "diggings" on Conn's Creek, one and a half miles below Waldron, Indiana.



(b) View of the Waldron shale below the iron bridge at Milroy, Indiana.

On the opposite side of the creek from the quarry, and only a few yards down the creek, are the famous Waldron shale fossil beds. But little digging has been done here for years, and the exposures are almost completely covered by debris. From the poorly exposed strata the following section was obtained:

	Ft.	In.
1. Drift	10	..
2. Light grayish, poorly bedded non-fossiliferous limestone	3	6
3. Waldron shale, light gray to light blue and drab...	1	..
4. Covered to bed of creek.....	4	6
	19	..

Two hundred yards down the creek, and on the west side, there is a good exposure of the shale. The following section was made at this exposure:

	Ft.	In.
1. Soil	4	..
2. Light, sandy Devonian limestone.....	2	..
3. Thin bedded, rather hard, grayish to blue limestone (the Hartsville bed).....	5	6
4. Shale and shaly limestone.....	4	8
	16	2

The upper 21 inches of the shale consists of shale and shaly limestone with alternate thin streaks of clay and clayey shale. The discontinuous shaly limestone courses run from naught to four inches in thickness. Below this upper division of the shale occurs 18 inches of shale with an occasional, irregular mass of shaly limestone. Below this division occurs 11 inches similar to the top division. The bottom division consists of rather hard, shaly limestone. At the north end of the exposure the shale and shaly limestone turns to a harder shale and thin bedded limestone. The shale is exposed for a distance of about forty yards. Near the southern end of the exposure there is one very large, irregular, fossiliferous mass of limestone and limestone shale. The lower half of the shale seems to have the greater number of fossils. Below the shale to the bed of the creek there is exposed 18 inches of Laurel limestone.

In the accompanying view of this exposure (see Plate III) the large mass of limestone is seen to the left in the foreground. The best exposure of the Waldron shale is seen to the right of the limestone mass. Above the shale is the somewhat poorly bedded Hartsville limestone.

Following down the creek for only a short distance there is a sharp turn in the stream. Along on the east bank there are a number of

springs which seem to come from just above the Waldron shale horizon. Near the mouth of these springs and along on the bank only a few feet above the bed of the creek occurs a heavy deposit of calcareous tufa, presumably deposited by the spring water. The entire mass, running almost to the foot bridge below, a distance of some 400 yards, is a loose, spongy mass having a very characteristic tufaceous texture.

At the east end of the foot bridge, across Conn's Creek, in the southeast quarter of the southeast quarter of section 6, one and three-fourths miles below Waldron, the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Drift and soil.....	15	..
2. Sandy limestone	2?	..
3. Hard, grayish, and at places sandy limestone in courses 5 to 8 inches thick.....	3	..
4. Irregularly, thin bedded, non-fossiliferous limestone	3	6
5. Shale and shaly limestone, light grayish where long exposed, but more of a slate color where newly exposed	1	6
6. Fossiliferous shale	3	..
7. Covered	?	..
8. Hard, blue, irregularly bedded Laurel limestone..	6	..
Bed of creek.....	0	..

Section at the small water falls in the small ravine south of Mr. Fred Stickford's residence in the southeast quarter of the southeast quarter of section 6, two miles south of Waldron:

	<i>Ft.</i>	<i>In.</i>
1. Drift	12	..
2. Thin bedded, rather hard, grayish, arenaceous limestone	7	..
3. Shale and shaly limestone.....	1	6
4. Covered to creek bottom.....	8?	..
	28	6

Section along a small ravine south of Mr. G. W. Carlisle's residence in the southeast quarter of the southeast quarter of section 6, two miles south of Waldron:

	<i>Ft.</i>	<i>In.</i>
1. Hard, irregularly bedded limestone.....	3	..
2. Covered	2	..
3. Shaly limestone, with Waldron shale fossils.....	..	2
4. Shale and clay.....	..	2
5. Shaly limestone .....	..	4
6. Shale .....	..	1½

	<i>Ft.</i>	<i>In.</i>
7. Shaly limestone		1½
8. Shale		1
9. Shaly limestone		3
10. Shale		1
11. Shale and shaly limestone.....		5
12. Shale and shaly limestone.....		3
13. Shale		6
14. Covered		1½
15. Hard, grayish to blue limestone.....		6
16. Hard, blue limestone.....		5
17. Hard, blue limestone.....		6½
18. Hard, blue limestone.....		3½
19. Hard, blue limestone.....		5
20. Hard, blue limestone.....		8
21. Hard, blue limestone.....	1	9
22. Light to blue shaly limestone.....		3
23. Shale and shaly limestone.....	3	..
24. Hard, blue crinoidal limestone.....		6
25. Hard, blue, irregularly bedded limestone.....	1	1½
26. Blue to slightly reddish limestone.....		8
27. Reddish to a dull-colored limestone.....		4*
28. Bed of Conn's creek.....	0	..

18 1

Below is given the correlation of the strata in the foregoing section.

Nos. 3 to 13, inclusive, belong to the Waldron shale. The alternation of the shale and the shaly limestone strata is very noticeable in this section. This horizon was very fossiliferous, a number of good Waldron shale specimens were found. Nos. 15 to 21, inclusive, belong to the Laurel limestone. The Laurel courses are thinner here than at most exposures, and the total thickness of this formation has decreased decidedly, for below No. 21 occur the Osgood limestone and shale. These Osgood beds are only exposed at this one place, being covered above and below and presumably dipping below drainage. The exposure is along the roadside near Mr. Carlisle's barn. Dr. Washburn, a local paleontologist, of Waldron, reported having found a number of cystideans at this place. From here to the mouth of Conn's Creek, the country rocks are covered.

The somewhat circular field, shown on the accompanying map at the mouth of Conn's Creek marks, in a general way, the area included in the gas explosion, which occurred at this place August 11, 1890. The local accounts vary somewhat with reference to the violence of this "blow-out." The prevailing, and what seems to be the correct one, is as follows: Following the heavy explosion, which threw rocks, soil, mud, etc., to a height of three hundred feet or more, came a blaze

which ran higher. The escaping gas was ignited from a fire then burning in old driftwood near by. Large fissures were formed in the earth's crust, one of which crossed Flat Rock Creek just above the mouth of Conn's Creek, and into which the creek flowed for 24 hours. A few banks and depressions remain to mark the site of the explosion. A number of clay relics, made from the ejected clay, are kept by the citizens of the neighborhood.

Above the mouth of Conn's Creek, on the west side, the line marking the supposed position of the Waldron shale turns to the west and follows in a westerly direction across the east half of section 12, and then turns to the southwest to the creek's bank at the southwest corner of the section. It is more than probable that at some time Flat Rock Creek flowed west across the north part of the east half of section 12, and then turned south and joined its present channel. Between its old channel and its present one occur some rather high sand and drift hills.

A section of the west bank of Flat Rock Creek west of Geo. Wright's residence, in the northwest quarter of the northwest quarter of section 13, one and three-fourths miles above Geneva, is as follows:

	<i>Ft.</i>	<i>In.</i>
1. Sandy limestone	2?	..
2. Thin bedded, light grayish to blue limestone.....	5	6?
3. Shale and shaly limestone.....	2	..
4. Covered	2	..
5. Shaly limestone .....	..	6
6. Hard, blue limestone in courses from 2 to 10 inches	5	6
	17	6

The wagon road along the creek at this place follows the horizon of the Waldron shale for some three hundred yards.

The following section of the east bank of Flat Rock Creek, fifty yards above the forks of the road, in the northwest quarter of the northwest quarter of section 13, and 200 yards southwest of Geo. Wright's residence, was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Drift	15	..
2. Grayish limestone	1	6
3. Grayish limestone .....	..	10
4. Grayish limestone .....	..	6
5. Hard, grayish to blue limestone.....	1	7
6. Hard, grayish to blue limestone.....	..	10
7. Hard, grayish to blue limestone.....	1	7

	Ft.	In.
8. Shale and shaly limestone.....	5?	..
9. Hard, blue limestone.....	..	9
10. Hard, blue limestone.....	..	6
11. Covered to creek.....	..	8
	28	9

The Waldron shale is very fossiliferous, and this is an excellent place to gather Waldron shale fossils.

The following species were recognized:

Rhyncotrete cuneata, *Atrypa reticularis*, *Meristina nitida*, *Orthis hybrida*, *Spirifera crispa*, *Rhynchonella neglecta*, *Rhynchonella indianensis*, *Rhynchonella whitii*, *Favosites forbesi*.

At the forks of the road along Flat Rock Creek, at the east side of section 14, there is an exposure of some 12 feet of rather soft, massive, sandy limestone the base of which is probably eight feet above the creek.

A section of the west bank of Flat Rock Creek, one-half mile above Geneva, is as follows:

	Ft.	In.
1. Soft, massive, arenaceous limestone.....	5	..
2. Soft, sandy limestone.....	..	5
3. Hard, grayish limestone.....	..	7
4. Hard, light grayish to bluish limestone.....	..	4
5. Hard, light to bluish limestone.....	..	4½
6. Hard, light to bluish limestone.....	..	7½
7. Hard, light to bluish limestone.....	..	3½
8. Hard, light to bluish limestone.....	1	..
9. Hard, light to bluish limestone.....	..	3
10. Hard, light to bluish limestone.....	..	3
11. Hard, light to bluish limestone.....	..	7
12. Hard, light to bluish limestone.....	..	4
13. Hard, light to bluish limestone.....	..	11
14. Hard, light to bluish limestone.....	..	6
	11	5½

There is a slight unconformity between Nos. 1 and 2. Nos. 3 to 14, inclusive, belong to the Hartsville bed, corresponding to the stone quarried at the Avery quarry near Waldron. Some little stone has been quarried at this exposure. The bottom of the quarry is probably three feet above the bed of the creek. The Waldron shale probably lies below the quarry and near the creek bed.

The following is a section of the south bank of Flat Rock Creek at the turn in the stream three-eighths of a mile above Geneva:

	<i>Ft.</i>	<i>In.</i>
1. Soft, massive, sandy limestone.....	12	..
2. Irregularly bedded limestone.....	1	6
3. Hard, gray to blue limestone.....	6	6
4. Bed of creek.....	0	..
	<hr/>	<hr/>
	20	..

The Waldron shale has passed below drainage. The rocks have a decided dip to the west.

Section taken at the Gregory limekiln at Geneva:

	<i>Ft.</i>	<i>In.</i>
1. Drift	3	..
2. Thin bedded limestone.....	2	..
3. Impure limestone	1	6
4. Grayish, thin bedded limestone, courses running from 2 to 6 inches.....	2	2
5. Continuous stratum of limestone.....	3	4
6. Thin bedded limestone.....	2	6
7. Hard, grayish limestone.....	..	3
8. Hard, grayish limestone.....	..	4
9. Hard, grayish limestone.....	..	3½
10. Hard, grayish limestone.....	..	9
11. Hard, grayish limestone.....	..	3
12. Hard, grayish limestone.....	..	2
13. Hard, grayish limestone.....	..	10
14. Hard, grayish limestone.....	..	2
15. Hard, grayish limestone.....	1	5
16. Hard, grayish limestone.....	..	10
17. Hard, grayish limestone.....	..	8
18. Bottom of quarry, which is about 15 feet above the bed of the creek.....	0	..
	<hr/>	<hr/>
	20	5½

One hundred and fifty yards above the mouth of Douglas Creek, in the northeast quarter of the southeast quarter of section 14, and one-half mile above Geneva, the following section was made at the upper end of the gorge along the creek:

	<i>Ft.</i>	<i>In.</i>
1. Massive, arenaceous limestone, which grows harder from top to bottom.....	7	..
(This stratum forms projecting ledges along the sides of the narrow gorge.)		
2. Hard, light to bluish limestone.....	..	8
3. Hard, light to bluish limestone.....	1	1
4. Hard, light to bluish limestone.....	..	6

	<i>Ft.</i>	<i>In.</i>
5. Hard, light to bluish limestone.....	..	2
6. Hard, light to bluish limestone.....	..	2
7. Hard, light to bluish limestone.....	..	2
8. Hard, light to bluish limestone.....	..	3
9. Hard, light to bluish limestone.....	..	2
10. Hard, light to bluish limestone.....	..	3
11. Hard, light to bluish limestone.....	..	2
12. Hard, light to bluish limestone.....	..	2
13. Soft, sandy limestone, which forms the top layer of the Waldron shale.....	..	10
14. Shale .....	..	6+
15. Bed of creek.....	0	..
	<hr/>	<hr/>
	12	1

Purely from a lithological standpoint, the following correlation was made of the exposures at this place:

No. 1 the base of the Devonian; Nos. 2 to 12, inclusive, the upper division of Upper Silurian, or the Hartsville bed; and Nos. 13 and 14 the Waldron shale. Between the sandy Devonian limestone and the underlying hard to bluish Silurian formations, there exists a slight unconformity. The Silurian rocks dip to the west. This unconformity is similar to others referred to in this report, and which indicate that there must have been an elapse of no short intervening period between the deposition of these two formations. A small cascade exists at the head of the gorge. Above the cascade the Devonian is exposed in the bed of the creek.

The following report was given by the drillers of the Geneva gas well, which was just completed at the time of my visitation:

	<i>Ft.</i>	<i>In.</i>
1. Drift	1	6
2. Hard limestone, free from shale.....	150	..
3. Shale	30	..
4. Hard, brown sandstone (?).....	45	..
5. Shale	500	..
6. Trenton limestone	17	..
	<hr/>	<hr/>
	743	6

A light flow of gas was struck.

A number of observations were made along Flat Rock Creek below Geneva. At the cross roads in the north half of section 22, one mile below Geneva, there occur in the bed of the creek excellent exposures of the sandy, Devonian limestone.

At Flat Rock Cave, one-fourth mile above Bynum, on the north side of the creek, there is an exposure of heavy, sandy limestone. The cave, which occurs near the base of this exposure, is near high water mark. Below the heavy limestone and below the entrance to the cave, two feet of thin, irregularly bedded limestone is exposed. Above the heavy, massive, sandy limestone, some eight feet of hard, light to blue, thin, irregularly bedded limestone is exposed.

Below the bridge at Bynum there is an exposure of some 12 or 15 feet of irregularly bedded limestone. At the top of the exposure, as seen on the west side of the creek, there is some five feet of hard, bluish limestone. Below this there occurs some seven or eight feet of irregularly bedded limestone to bed of creek. At places in this exposure there is an alternation of hard, blue and sandy limestone strata. The limestone found along the creek at Geneva has probably passed below drainage at this place, and the sandy limestone here probably represents a larger division of the Devonian. The exposure is non-fossiliferous.

Two miles south of Bynum, on the road to Norristown, the drift was reported two to five feet thick, with fifty feet plus of hard underlying limestone. West of the road and north of a small branch near the center of the east side of section 29, one-half mile north of Norristown, is an outcrop of nine or ten feet of poorly exposed limestone. The limestone seems to be poorly bedded, with a pale blue to light blue color, and at places quite soft and sandy, especially where long exposed. Near the top of the exposure are two strata of chert two to five inches thick.

Some five miles east of Norristown, along Duck Creek, exposures of the sandy Devonian limestone were noted at the following places: In the northeast quarter of the northwest quarter of section 33; near the center of the north side of section 32; and at the southwest corner of section 32. The drift in the vicinity of Duck Creek runs from 3 to 35 feet.

At Middletown, on Conn's Creek, one mile above Waldron, there is an exposure of the sandy limestone in the bed of the creek just west of town. Shale was reported in the creek, but an examination failed to verify the report. However, at the time of the examination the creek was slightly swollen, and it is barely possible that the shale does outcrop. Judging, however, from the sandy limestone, the horizon of the shale seems to be some eight or ten feet below the bed of the creek. The stone exposed lithologically corresponds to the sandy limestone above the Hartsville bed at the Avery quarry, below Waldron. To the west and northwest of Middletown the country is level

dissected here and there by narrow, post-glacial valleys. A number of observations were made along Conn's Creek and its tributaries above Middletown, but the country rock was concealed by the rather heavy drift.

RUSH COUNTY.

Rush County lies north of Decatur County, and is bounded on the east by Fayette and Franklin counties, on the west by Shelby and Hancock counties, and on the north by Hancock and Henry counties. Only the southwestern portion of the county is included in this report. The area mapped has a breadth of nine miles north and south and a length of 15 miles east and west. Milroy, the largest village in the mapped area, lies east and south of the center. The territory is drained by Big and Little Flat Rock creeks. The topography and surface geology is in a general way similar to that of the adjacent counties described above.

DISTRIBUTION OF THE WALDRON SHALE.

Section of the east bank of Little Flat Rock Creek, 40 yards below the bridge at Milroy:

	<i>Ft.</i>	<i>In.</i>
1. Soil	5	..
2. Irregularly bedded, grayish to dark-colored, arenaceous limestone	4	..
3. Shale	2	1
(a) Shale and clayey shale.....	..	2
(b) Shale to shaly limestone.....	..	1 to 3
(c) Blue to drab shale.....	..	16
(d) Shaly to shaly limestone.....	..	4
4. Laurel limestone in the bed of the creek.....	0	..
	11	1

No. 2 breaks down in small, irregular, sharp-cornered pieces, increasing in size from top to bottom. It is non-fossiliferous. Years ago the stone was burned for lime. The shale is exposed for 100 yards or more along the east bank of the stream. On Plate III is given a view of the exposure at this place.

The Waldron shale at the bridge seems to be in the trough of a gentle synclinal fold, for one-fourth of a mile above the bridge the shale horizon is more than two feet above the bed of the creek, and one-half mile below the bridge eight feet above the bed of the creek. Above the bridge the Laurel limestone forms the bed of the creek for one-fourth mile or more. The shale is exposed 150 yards above the bridge, where it is one and one-half feet above the creek. In following up the creek the shale disappears. On the south bank of the creek, just above where the branch enters from the north, near the center of section 12, the shale is absent, the sandy, irregularly bedded limestone resting directly on what seems to be the Laurel beds. The exposures are poor, and non-fossiliferous. One stratum is present which resembles the base of the shale. If the underlying limestone is really the Laurel limestone it has changed from its usual color, having at this exposure a dull red to brownish color.

Above the railroad bridge northeast of Milroy, in the bed of the creek, occur good exposures of the arenaceous limestone, which lies above the Laurel beds. This indicates that the horizon of the Waldron shale has passed below drainage. Owing to the more or less covered condition of the exposures, it was impossible to determine just where the shale passes below drainage. In fact, it seems that the shale is absent just north of Milroy and that the Devonian (?) rests unconformably upon the Laurel beds. It is possible that denudation removed the shale during the intervening period between the deposition of these two formations. The sandy limestone passes below drainage in section 7, northwest of Milroy, not reappearing along the head waters of the creek. Observations were made at a number of places along Conn's Creek and the head waters of Little Flat Rock Creek, and together with reports gathered from the farmers warrant the above statement. Observations were extended eastward to and beyond the north fork of Clifty Creek, but no Devonian limestone was observed. To the east the Laurel and Osgood beds were noted. The eastern extension of the Devonian is concealed beneath the drift. At Bulltown, on Salt Creek, east of Andersonville, the Laurel and Osgood beds are exposed.

The exposures along Clifty Creek are covered. In the creek valley one mile east of Richland, at the Anderson gas well, the drift was reported 122 feet thick; at Richland from 50 to 80 feet.

Section at the Rarden quarry, on Little Flat Rock Creek, one-half mile below Milroy:

	<i>Ft.</i>	<i>In.</i>
1. Soil	2	..
2. Thin, irregularly bedded limestone.....	2	..
3. Shale		8
(a) Shale and clayey shale.....		1%
(b) Shale and shaly limestone.....		5%
(c) Clayey shale		%
4. Hard, blue Laurel limestone in regular courses running from 2 to 6 inches.....	6	..
5. Laurel limestone with chert nodules.....	3	..
6. Bed of creek.....	0	..
	18	8

The shale grows thinner in going down the creek, running from four to eight inches. The exposure of shale at the quarry is about fifty yards long. On the opposite side of the creek, near the little spring, the shale seems to be absent.

South of the bridge, locally known as the White Bridge, across Little Flat Rock Creek south of Milroy, there is an exposure of eight feet of chert and thin strata of limestone, evidently the upper beds of the Laurel limestone. On the north side of the creek there is a large gravel pit. From this point south to Decatur County, the location of the shale horizon is uncertain. The drift is heavy, and very rarely do exposures of country rock appear. In the road along the north side of the northeast quarter of section 26, there is an exposure of the Laurel beds. Following the road west to the creek and then following up the creek for a short distance, there occurs an exposure of thin courses of limestone. The exposure forms a cliff seven feet high. It is seen best on the east side of the creek.

MOSCOW AND VICINITY.

Section of the northeast bank of Big Flat Rock Creek, 200 yards above the bridge at Moscow:

	<i>Ft.</i>	<i>In.</i>
1. Irregularly bedded limestone.....	7	..
2. Dull brownish, arenaceous limestone.....	4	6
3. Laurel (?) limestone, courses 2 to 4 inches thick....	2	6
4. Covered to bed of the creek.....	2	..
	16	..

Section of the same bank thirty yards farther up the creek:

	<i>Ft.</i>	<i>In.</i>
1. Sandy limestone, massive to poorly bedded.....	15	..
2. Shale and clayey shale.....	..	3
3. Shale to shaly limestone.....	2	6
4. Hard, bluish Laurel limestone.....	3	..
5. Bed of creek.....	0	..
	20	9

Nos. 2 and 3 mark the portion of the Waldron shale which is here quite calcareous. Following the exposure of the shale up stream it gradually grows thinner, until its thickness is only 11 inches where it disappears. At this point of disappearance it is divided into two fairly well defined strata; viz., two inches of shale to clayey shale and nine inches of shale to shaly limestone.

The sandy limestone at the top of the section forms quite a large cliff, with here and there overhanging ledges. On Plate IV is given a view of the cliff with its more or less irregularly bedded strata forming the greater part of the picture. To the right, where the vegetation has been removed, is seen a dark spot locating the horizon of the shale. The disintegration of the shale forms a soil in which many forms of plant life take root. Above and below this horizon, owing to the absence of soil, plant life is not so abundant. To the left of the dark spot, marking the position of the shale, is seen the heavy growth of plant life, while above and below this horizon but few forms of plant life are seen. In the foreground is the rather smooth surface of the Laurel limestone. The exposures are non-fossiliferous. If the Hartsville bed occurs here, it resembles so closely the overlying limestone that no distinction can be made. Following up the stream from this, the last exposure of shale above the bridge, the Laurel limestone soon passes below drainage, and the Devonian(?) limestone occurs in the bed of the creek.

Section of the north bank of Big Flat Rock Creek, near the center of the east side of section 6, one mile northeast of Moscow:

	<i>Ft.</i>
1. Hard, dull-colored, irregularly bedded, and at places sandy, limestone	15

Near the bottom of the exposure occurs a rather heavy sandy stratum. Above the small cliff formed by these exposures occurs an outcrop of dull grayish limestone. Following down the creek for one-fourth mile, the same exposures, as found in the cliff, outcrop. At the ford on the road to Moscow the top half of the exposure is thin

bedded, while the lower half is more or less massive. These exposures form cliffs at the sharp turns in the creek. From this point north, observations were made along the creek as far north as Rushville. At most places the bed of the creek consists of sand, clay and gravel. However, near the northeast corner of section 6, two and one-half miles above Moscow, the following section was obtained.:

	<i>Ft.</i>	<i>In.</i>
1. Irregularly bedded, hard, grayish to blue crystalline limestone	5	6
The lower ledge of this outcrop forms a projecting rock of two feet or more, and runs along the creek bank for 225 yards.		
2. Hard, flinty limestone.....	3	5
This outcrop breaks down in very irregular, sharp-cornered pieces.		
3. Hard, dark bluish to reddish limestone to bed of the creek	1	..
	9	11

The noticeable change in the structure of the outcropping rocks along the creek, in following up the stream from one-half mile above Moscow, is the gradual transition from a more or less soft, arenaceous structure to a hard, flinty structure.

Section of the southwest bank of Big Flat Rock Creek, 200 yards below the bridge at Moscow:

	<i>Ft.</i>	<i>In.</i>
1. Rather hard, dull to grayish sandy limestone..	4	..
2. Clay to clay shale.....	..	2 to 4
3. Shale to shaly limestone.....	3	8
4. Shale to shaly limestone, forming the base of the Waldron shale .....	..	6
5. Thin bedded Laurel limestone.....	3	..
6. Thicker bedded Laurel limestone.....	2	6
7. Bed of creek.....	0	..
	14	..

The Waldron shale at this exposure is slightly fossiliferous. An exposure of Waldron shale three feet thick occurs on the opposite side of the creek, just below the east end of the bridge.

Following down the creek one-fourth mile from Moscow, exposures of the shale are found in the east bank. At the upper exposure, the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Irregularly, bedded, arenaceous limestone.....	4	8
2. Arenaceous limestone	2	3
3. Clay to shale, with 2 inches of shelly limestone at the bottom	1	5½
4. Hard, regularly bedded Laurel limestone to bed of the creek	12?	..
	20	4½

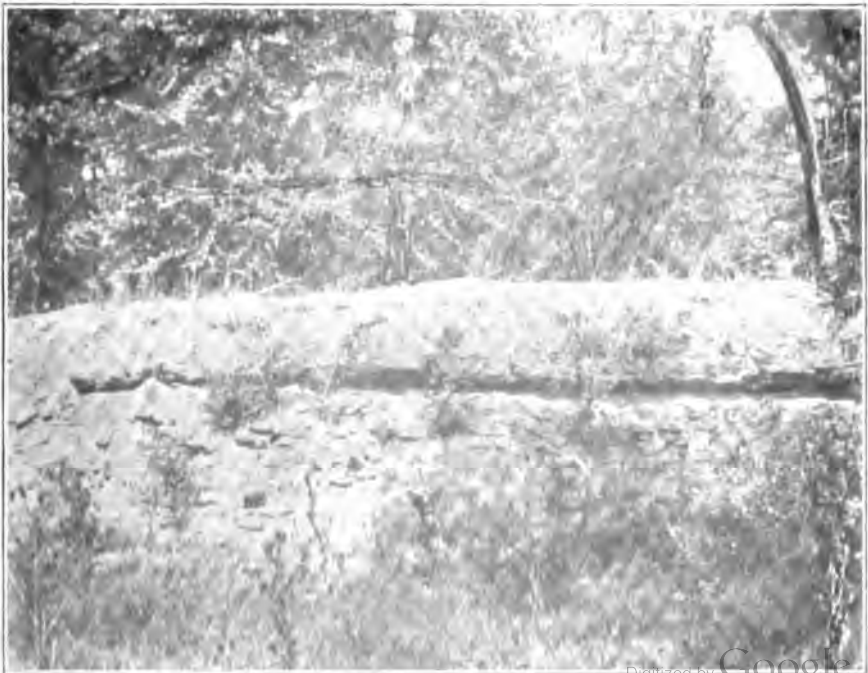
Some 250 yards farther down the creek, and on the east side, is an old quarry, where the following section was obtained:

	<i>Ft.</i>	<i>In.</i>
1. Irregularly thin bedded, grayish arenaceous limestone	4	..
2. Shale and clayey shale.....	1	6
3. Shaley limestone, forming the base of the Waldron shale		3
4. Laurel limestone		3½
5. Laurel limestone		2
6. Laurel limestone		3½
7. Laurel limestone		4
8. Laurel limestone		3
9. Laurel limestone		3½
10. Laurel limestone		5
11. Laurel limestone		4
12. Laurel limestone		2
13. Laurel limestone		2
14. Laurel limestone		6
15. Laurel limestone		3
16. Laurel limestone		5
17. Laurel limestone		5
18. Laurel limestone		3
19. Laurel limestone		4
20. Laurel limestone		5
21. Laurel limestone		5½
22. Laurel limestone		8
23. Laurel limestone		5
24. Chert streak		2
25. Covered to creek.....	2	..
	14	9



a

(a) View of the cliff above the bridge across Big Flat Rock Creek, Moscow, Indiana.



b

(b) View of the east bank of Big Flat Rock Creek, one fourth mile below Moscow, Indiana.

On Plate IV is given a view of the exposures at this place. The horizon of the Waldron shale is marked by the horizontal line near the center of the picture. Below this horizon is seen the thin, regularly bedded Laurel limestone courses. The exposures are non-fossiliferous. The Waldron shale has an average thickness of 20 inches.

Some 200 yards below the exposure shown in the picture, and on the same side of the stream, the Laurel limestone is exposed, with intervening chert layers. The Waldron shale and overlying limestone are covered.

At the old mill dam in the southwest quarter of the southwest quarter of section 20, one and one-fourth mile below Moscow, seven feet of limestone and intervening chert layers are exposed, presumably the upper courses of the Laurel limestone. At this point and south to the county line the location of the line marking the Waldron shale horizon is largely an arbitrary matter. Observations were made along Little Hurricane Creek, but no rock exposures were found. The drift runs from 20 to 50 or more feet in thickness.

REPORT OF STATE INSPECTOR OF MINES.

OFFICE OF INSPECTOR OF MINES,
INDIANAPOLIS, IND., January 20, 1900.

PROF. W. S. BLATCHLEY, *State Geologist*:

DEAR SIR—I have the honor to submit to you herewith the annual report of the Inspector of Mines for the year 1899, as required by section 7454 of the Revised Statutes of Indiana by Burns.

JAMES EPPERSON,
Inspector of Mines.

INTRODUCTION.

In his letter of transmittal, dated January 17, 1899, accompanying his annual report for the year of 1898, my predecessor, whose term of office, as Inspector of Mines, did not expire until March 11, 1899, declared his purpose of filing a supplemental report, covering the balance of his term. This, however, he failed to do, but agreed to furnish the necessary data for that purpose, when the time came to make up my annual report. Mr. Fisher's sudden death precluded him from doing so. I have been unable to find a number of papers and reports for that period of 1899 included in his term, which would have assisted me in getting up my report. Among other data which I have been unable to secure, is the list of persons who were examined at Brazil in February, together with the names of those to whom certificates of competency were issued at that examination; also the list of persons to whom he had issued service certificates during that period.

This report includes, or covers, the following topics or subjects, arranged in the order enumerated: Introduction, review of coal trade, table of production, table of wages paid employes, labor troubles, general table, mine maps, table showing the owners of mines and addresses, examinations, list of mine bosses and addresses, new electric motor, table of fatalities and tonnage by years, legislation, legislation recommended, table of accidents, abandoned mines, description of new mines, and Indiana Mining Institute.

REVIEW OF COAL TRADE.

The condition of the coal trade during the past year has been, as a whole, very satisfactory. In tonnage, it makes the largest production in the history of the State, exceeding 1898 by 718,053 tons, that year having the next highest record in number of tons produced, making an increase of about 14 per cent. This, too, notwithstanding that a good many mines in the southern part of the State lost considerable time during the spring and summer, on account of being involved in strikes, as noted in another part of the report; and notwithstanding that the winter, so far, has been exceptionally mild. The block coal operators depend to a considerable extent (now much more than formerly) upon domestic trade for a market for their coal, the tendency of manufacturers and other consumers at the present time being to use a cheaper coal, whenever possible.

During the past year the price of this product has not only been good, but the market has been firm, and the demand in excess of the supply. The prospect is that the coal trade will remain in a healthy condition throughout the ensuing year.

The probabilities are that the production of coal, during the present year, will greatly exceed that of last year. The number of new mines reported in this report is very much fewer than in last year's report, but there are a number of new ones almost ready for operation, that have not, as yet, reported to this office, and these, together with those reported, will exceed the number opened last year.

Nine new mines have been reported as completed for operation during the past year, distributed as follows: Clay County, 1; Fountain County, 1; Greene County, 1; Parke County, 2; Sullivan County, 4; total, 9.

Several other new mines are in contemplation, and a number of the older mines have largely increased their output by improvement and development. Not only are large sums of money being spent in equipping mines, new and old, in improved machinery, but capital is actively seeking investment in this industry, and much coal land is being purchased.

The Indiana Southern Railroad, built during the year through Greene, Sullivan, Clay and Vigo counties, has tapped a new coal field

that will, no doubt, be developed, and add to the supply of coal. It is probable, however, that by the time this is developed the production of some of the present coal producing fields will have been reduced somewhat by exhausted mines, and that this new field will not largely affect the total tonnage of the State.

As noted in another part of this report, the mine workers and operators are better organized than in years. Each of these organizations has learned wisdom and conservatism by past experience, and it is believed that no serious controversy will arise during the present year. This will have a tendency to increase the output of the State, and inure to the general benefit of the industry. A fair and equitable scale, observed throughout the State, will give to every operator a competitive chance in the coal market, enabling him to keep his mine running steadily, to the benefit of all concerned. Experience has demonstrated, time and time again, that lack of uniformity in the price paid for mining coal inevitably results in disaster to the coal trade.

TABLE

Showing the Production of Coal in Tons of 2,000 Pounds in Indiana, During the Year 1899, at Mines Employing More than Ten Men, by Months and by Counties.

COUNTY.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Clay	126,162	122,386	110,484	72,729	51,182	55,862	66,726	91,821	97,066	116,948	94,545	98,313	1,104,254
Daviess	19,875	12,988	7,802	12,857	13,891	13,776	12,729	12,883	11,490	17,248	15,490	16,038	167,009
Fountain	9,025	7,338	8,152	4,883	4,125	4,165	4,119	5,843	3,743	1,282	1,300	1,127	55,102
Gibson	10,549	9,819	4,318	4,792	Strike.	1,461	3,228	3,150	6,600	10,188	8,979	8,540	71,634
Greene	64,591	63,076	43,462	44,788	30,302	33,286	31,902	58,027	53,074	80,226	78,279	78,078	659,161
Knox	6,431	5,558	5,102	2,847	1,459	1,501	1,590	1,772	2,875	5,491	7,148	6,107	47,881
Martin	948	699	779	835	846	552	255	452	363	338	329	402	6,798
Parke	79,974	71,584	69,757	56,669	39,948	47,725	50,632	64,185	63,350	81,319	70,406	88,884	784,433
Perry	2,572	2,083	3,113	2,747	2,898	2,292	1,630	2,088	1,102	1,301	1,513	1,800	25,139
Pike	30,191	19,671	21,590	18,258	1,767	Strike.	1,489	1,897	2,527	15,902	31,804	28,799	173,905
Sullivan	77,008	60,897	72,948	63,499	61,468	53,017	56,068	65,068	64,008	69,542	78,541	63,545	790,609
Vanderburgh	21,520	20,632	16,473	13,385	6,394	6,274	5,513	7,380	10,875	14,132	14,380	15,905	152,883
Vermillion	66,463	52,862	36,376	50,939	46,762	52,519	47,529	47,894	54,973	61,873	69,074	72,578	659,842
Vigo	87,340	91,988	97,363	78,498	77,780	80,835	72,260	72,181	79,081	97,010	97,703	109,472	1,041,491
Warrick	13,890	10,145	6,989	6,437	2,850	2,017	5,544	5,646	3,690	5,571	7,778	29,015	99,572
Total	636,339	551,676	504,708	434,183	341,652	360,284	361,224	440,287	454,947	678,441	577,269	616,603	5,839,713
Estimated production of small mines													25,260
Grand total													5,864,973

TABLE

Showing the Wages Paid to Employes in Indiana, During the Year 1899, at Mines Employing More Than Ten Men, by Months and by Counties.

COUNTY.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Clay	\$103,199 46	\$101,516 89	\$95,022 78	\$52,791 52	\$46,886 75	\$52,883 26	\$63,286 54	\$80,768 04	\$82,012 68	\$100,860 50	\$61,020 28	\$85,666 64	\$947,424 34
Daviess	12,698 34	9,931 85	5,451 19	8,783 88	7,958 04	8,510 18	10,005 93	9,398 78	9,753 96	7,485 01	10,855 13	11,042 38	110,874 21
Fountain	6,287 85	5,400 50	5,830 00	3,708 80	3,258 16	3,584 30	3,635 05	3,098 80	2,144 03	905 00	970 00	850 00	99,603 09
Gibson	5,464 54	5,061 80	2,505 29	2,629 26	Strike.	1,548 89	2,222 97	2,283 95	3,992 79	5,252 04	5,311 70	4,981 00	41,851 23
Greene	36,048 99	34,758 47	24,388 86	27,887 80	21,254 83	19,839 42	15,624 20	31,380 82	30,193 74	42,382 41	41,866 09	41,816 39	367,500 52
Knox	4,216 09	4,141 30	3,512 76	2,079 93	1,988 73	1,186 35	1,182 16	1,325 67	2,287 62	3,139 20	4,888 46	3,648 78	32,762 05
Martin	549 43	487 07	489 00	522 00	498 00	350 80	156 50	282 25	248 00	230 00	276 50	315 00	4,402 55
Parke	56,019 96	50,529 18	58,234 71	43,274 10	29,839 92	37,652 69	44,249 31	52,310 63	55,556 34	63,994 37	54,427 54	66,074 93	614,163 68
Perry	2,026 30	1,722 79	2,378 22	2,190 66	1,852 46	1,812 38	1,451 71	1,713 57	1,179 80	1,396 00	1,553 87	1,900 00	21,217 26
Pike	15,758 33	14,356 15	11,742 32	10,100 41	476 61	282 50	818 75	1,248 25	1,991 99	11,598 68	20,696 45	16,783 25	105,831 69
Sullivan	40,368 90	33,576 87	38,285 38	32,301 70	24,898 72	23,263 34	22,983 69	28,018 96	36,586 52	38,227 43	44,276 97	36,277 61	398,928 09
Vanderburgh	15,176 55	15,509 15	13,176 50	10,645 40	4,698 83	4,975 65	5,222 45	3,688 10	10,464 99	10,192 05	12,656 55	12,224 40	118,028 62
Vermillion	35,350 53	28,122 72	26,358 60	27,421 30	27,584 61	29,430 88	26,066 18	25,981 96	29,871 59	34,382 00	38,356 38	39,891 54	368,818 29
Vigo	51,086 66	47,834 27	52,469 07	46,308 95	41,498 44	45,630 77	42,560 70	40,598 02	44,398 79	54,628 58	58,953 31	58,831 01	584,792 57
Warrick	5,206 37	3,564 80	3,705 91	2,668 60	1,562 46	1,504 00	2,050 00	2,500 00	1,565 00	1,450 00	3,865 85	15,333 21	44,976 20
Total	\$389,437 30	\$355,893 31	\$343,650 19	\$273,961 36	\$214,252 56	\$229,400 41	\$241,486 14	\$284,597 30	\$312,217 83	\$376,659 27	\$379,373 56	\$397,631 14	\$3,900,972 39
Estimated wages of all mines	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	12,640 00
Grand total.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	\$3,913,612 39

LABOR TROUBLE.

There were but few strikes of any consequence in the northern part of the State during the past year. The machine mine strike in the block coal field, if it can be called a strike, originated on the first day of April. In fact, none of the machine mines in the block coal field resumed work for about six weeks after the agreement as to the scale of prices was signed, on March 30. Prior to that time the machine miners had been paid by the day, at \$2.25 per day (27 cuts to constitute a day's work); and the cessation of work was to enable both the miners and operators to thoroughly analyze the scale and determine its effect, and occurred with the concurrence of all persons interested.

The next two strikes were at Summit No. 2 mine in Greene County, one of which was the cause of bringing out the entire Linton district, including eight mines. The strike was brought on through a disagreement as to the price paid for machine mining. Both strikes were settled amicably after a few weeks' idleness.

On March 30, the miners and operators of the organized part of the State met in Terre Haute and entered into an agreement as to the prices and conditions which should govern both parties from April 1, 1899, to April 1, 1900. The following is a copy of the agreement:

TERRE HAUTE AGREEMENT.

APRIL 1, 1899, TO APRIL 1, 1900.

The following agreement entered into in the Joint State Convention at Terre Haute, Indiana, March 29, 1899, by and between the bituminous operators and miners of the State, witnesseth:

First.—That the declarations of the contracts by and between the operators of the competitive coal fields and the United Mine Workers of America, entered into at Chicago, Illinois, January 24, 1898, and at Columbus, Ohio, March 10, 1898, and reaffirmed at Pittsburgh, Pennsylvania, January 24, 1899, be and hereby are reaffirmed in the identical terms therein employed.

Second.—That further details and scale of prices for pick and machine mining in the State of Indiana, for one year, beginning April 1, 1899, shall be as follows:

PICK MINING.

(Yardage.)

In entries seven to nine feet wide.....	\$1 37
In entries 12 feet, price shall be five-eighths of narrow work, or	85½

Wide entries shall not exceed 12 feet, it being understood that this applies to entry work only.

BREAK-THROUGHS.

Break-throughs in entries shall be paid for at entry price. Break-throughs between rooms, when sheared or blocked, shall be paid for at entry price, but no break-throughs shall be driven without the consent of the operator. Nothing herein shall interfere with strict compliance with the law governing break-throughs.

ROOM TURNING.

Room turning \$3 30

Room necks to be driven 12 feet in and widened at an angle of 45 degrees when so desired by operator. Any distance in excess of above shall be paid for proportionately.

MACHINE WORK.

(Yardage.)

In entries seven to nine feet wide..... \$0 98

In entries 12 feet wide, five-eighths of price for narrow entries, or 61

When the machine runners in 12-foot entries are paid by the day, and entry is not sheared, the shooters and loaders shall be paid two-thirds of the yardage. It is understood that this applies to entry work only.

BREAK-THROUGHS.

Break-throughs between entries, same as entry price. Break-throughs between rooms shall be paid for at entry price when similarly driven. This applies to width and not to method of mining.

ROOM TURNING.

Room turning \$2 47½

Room necks to be driven 12 feet in and widened at an angle of 45 degrees, when so desired by operators. Any distance in excess of the above shall be paid for proportionately.

When room necks are driven 12 feet wide, price shall be five-eighths of regular price, or..... \$1 54½

DAY WORK PUNCHING MACHINES.

Machine cutting, when paid for by the day, shall be for—

Cutter \$2 35

Helper 1 85

DAY WORK CHAIN OR CUTTER BAR MACHINE.

When paid by the day shall be—

Cutter	\$2 35
Helper	2 11

It being understood that a day's work shall not be less than twenty-seven (27) cuts. All cuts in excess of twenty-seven (27) shall be paid for proportionately.

PRICE PER TON FOR MACHINE MINING.

When paid for by the ton the price of coal mined by machines shall be three-fourths of the price paid for pick-mined coal, or..... \$0 49½

The price per ton after chain machines shall remain the same at the respective mines as during the year ending April 1, 1899.

BLACKSMITHING.

The price of blacksmithing shall be one and one-quarter cents (1¼) on the dollar, excepting after chain machines, where no blacksmithing shall be charged.

GENERAL.

Where the coal is paid for mine run, or on screened coal basis, it shall be mined, and when loaded on the miner's car, it shall, as nearly as possible, be free from slate, bone coal, sulphur and other impurities.

Payment for all labor shall be made twice a month, not later than the 10th and 25th of each month.

It is further agreed that the operators shall offer no objection to the check-off for checkweighman and for dues for the federation, provided that no check-off shall be made against any person until he shall have first given his consent in writing to his employer. This applies to all underground day work, as well as miners.

The time of beginning work in the morning and the length of intermission at noon shall be considered a local question.

It is further agreed that if any differences arise between the operators and the miners at any pit, a settlement shall be arrived at without stopping of work. If the parties immediately affected can not reach an adjustment between themselves, the question shall be referred without delay to a board of arbitration consisting of two operators selected by the operators interested and two miners selected by District No. 11, of U. M. W. of A. In event of these four being unable to reach a decision, they shall select a fifth man, and the decision of a board so constituted shall be final, but no miner or operator interested in the differences shall be a member of said board.

RESOLUTIONS.

Resolved, That while the number of stoppages for various causes during the past year has decreased, it is still the opinion of both miners and operators that sufficient attention has not been paid by either side to the agreement "that if any differences arise between the operators and miners at any pit, a settlement shall be arrived at without stopping work." It is the unanimous opinion of both miners and operators that this agreement should be strictly observed of both. We wish particularly to call attention to the fact that all such differences, even in event of stoppage, have been settled by arbitration and work resumed, and had the agreement been strictly observed, these stoppages would not have occurred, the same settlement would have been secured, and both miners and operators would have been saved the heavy losses caused by these stoppages.

That these resolutions be compiled in the form of a contract and signed by the President and Secretary of the United Mine Workers of America representing District No. 11, and the President and Secretary of the Bituminous Coal Operators' Association of Indiana; that they be printed and a copy sent to each and every mine and posted.

In witness whereof, we have hereunto subscribed our names this 30th day of March, 1899.

Attest:

W. D. VAN HORN,
President U. M. W. of A., District No. 11.

J. H. KENNEDY,
Secretary U. M. W. of A., District No. 11.

Attest:

J. SMITH TALLEY,
President Bituminous Coal Operators' Association of Indiana.

J. W. LANDRUM,
Secretary Bituminous Coal Operators' Association of Indiana.

At that time, however, the organization of miners and operators only extended as far south as the Baltimore and Ohio Southwestern Railroad. South of that point, at nearly all of the mines, the price paid for mining and day work was considerably below that agreed upon at the Terre Haute convention. During the latter part of April and the first part of May, the miners in the southern part of the State organized and demanded the scale prices paid in the northern part of the State, which the operators refused to pay, and the result was a strike at nearly all the mines south of Washington. A number of the mines, however, were idle but a short time, when the operators agreed to pay the scale prices and started their mines. A majority of these, however, were operating small mines. The strike was continued among the larger mines for some time. The Sunnyside Mine, at Evansville, was the first to pay the scale prices and resume work. W. S. Little, of the Little's Mine, and David Ingle, of the Ayershire Mine, were next to

fall in line. The operators of the First Avenue and Ingle mines, at Evansville, steadily refused to conform to the Terre Haute agreement, and continued to operate their mines, to a small extent, with non-union men until about November 1, when they also agreed to pay the scale prices, and are now included among the union mines of the State. This leaves less than one hundred men, working at shipping mines in the State, who are not in the organization.

There was very little disorder during these strikes except at Evansville, where there was some trouble. The most serious disturbance at this point was the lamentable shooting of J. Moore, an operator, while on his way to the mine with a company of non-union men. The shooting was done under cover of darkness, from ambush, and it is not known who did it. Mr. Moore was severely wounded; and, at one time, it was thought his wound would prove fatal: but he has, however, recovered, and is now able to attend to his duties again.

A very peculiar condition existed in the coal industry during the last fall and winter. Early in the fall, under the influence of the prosperity sweeping over the country, the price of coal, in common with the price of all other products, as well as the price of labor, advanced rapidly. The wages of mine workers, however, was governed by the scale of prices agreed upon at the Terre Haute convention; and they were bound by this agreement to continue working under it until April 1, 1900. In the meantime, many coal operators were reaping a rich harvest by reason of the wide margin between the cost of producing and the market value of their coal. A large number of the operators, however, had existing contracts based upon this scale of prices, and were not benefited by the advancing market, except as to coal which they were able to produce in excess of existing contracts. Under these conditions, it is not very strange that the miners should become restive and desire to have their wages advanced, the same as craftsmen in other industries. The engineers at coal mines, who were bound by no schedule of prices, received a substantial advance in their wages, and some operators, in the spirit of petulance, on account of the advance in wages conceded to the engineers, voluntarily increased the wages of the day men in their employ. All this tended to increase the discontent among the mine workers, especially as they had no means of knowing what prices their employers were getting for their coal. It is to be noted to the credit of the mine workers, however, that they kept faith with the operators by sticking to their agreement. Much credit is due the several officers and leaders of the mine workers for their persistent insistence on the keeping of the Terre Haute agreement. It is highly probable, however, that, before this report reaches

the public, all mine workers will have received a substantial increase in wages. Mine workers have learned from experience that strikes and lockouts, which lead to violence and the destruction of property, are unsatisfactory and ineffective remedies as a rule, and that the mine workers and the operators have a common interest. It is to be hoped that this striking example of fidelity to their agreement, on the part of the mine workers, will inspire confidence in their employers and will bind the two organizations closer together in the bonds of interest and sympathy.

TABLE

Showing the Average Number of Men and Mules Employed, Days Worked, Accidents Occurring, Kegs of Powder Used, Total Coal Produced, Total Wages Paid and the Total Improvements at Each Mine Reporting to this Office in 1899.

CLAY COUNTY.

NAME OF MINE.	EMPLOYED.			Days Worked.	ACCI- DENTS.		Kegs of Powder Used.	Tons Coal Pro- duced.	Wages Paid.	Improvements.
	Men Inside.	Mules.	Men Outside.		Fatal.	Non-Fatal.				
Brasil B. C. Co. No. 10.	23	2	4	40	...	...	49	3,188	\$6,196	68
Brasil Block No. 1	91	7	12	234	1	2	1,014	58,715	50,948	13
Gart No. 3	85	9	9	182	...	2	1,199	41,164	43,231	27
Gart No. 5	180	10	10	210	...	3	1,553	44,609	63,687	82
Brasil Block No. 7	...	...	...	...	...	...	...	...	...	...
Brasil Block No. 8	106	10	15	219	...	1	2,331	92,901	82,351	91
Brasil Block No. 11	61	5	5	299	...	3	897	43,819	40,274	40
Gladstone	70	10	8	217	...	2	1,774	44,209	46,054	42
Briar Hill	19	2	5	104	...	2	...	4,652	6,673	63
Harrison No. 2	43	4	6	196	...	1	818	23,432	20,132	00
Harrison No. 3	24	3	3	197	...	1	458	13,004	10,302	00
Pratt	61	6	6	164	...	2	...	26,995	25,606	00
Crawford No. 3	66	3	6	130	...	...	211	16,223	14,647	13
Crawford No. 4	72	3	5	207	...	1	1,745	39,949	32,165	91
World's Fair	34	2	3	195	...	...	160	17,046	14,095	75
Diamond No. 3	60	3	5	160	...	...	3,446	63,331	56,056	66
Eureka No. 2	96	9	6	131	...	7	1,630	39,527	36,856	10
Eureka No. 3	63	5	5	200	...	...	837	41,333	34,893	00
Monarch	17	3	1	290	...	...	...	7,200	...	...
Brasil	41	3	4	117	...	1	115	14,121	15,525	34
Markland	29	4	7	229	...	...	782	14,784	12,844	10
Fairview	36	4	3	193	...	1	280	14,806	17,314	64
Louise	23	2	3	92	...	...	90	6,528	10,234	89
Columbia No. 4	61	3	4	226	1	1	1,594	29,894	32,513	32
Klondyke	163	9	9	196	...	2	2,395	133,549	70,145	99
Silverwood No. 3	40	3	5	244	...	...	...	27,421	20,648	35
San Pedro	47	5	7	259	...	...	787	44,412	24,669	20
Rob Roy	35	2	5	...	...	2	384	13,335	10,512	19
Columbia No. 5	111	5	6	179	...	...	869	54,365	48,925	38
Dewey	81	3	4	166	...	...	294	41,230	35,401	49
Crawford No. 5	102	3	7	244	...	6	2,391	51,672	47,606	58
Prairie No. 3	20	2	2	70	...	...	10	2,002	2,021	20
Diamond No. 5	23	2	4	40	...	...	49	3,138	6,196	68
Cloverland	60	3	3	98	...	...	222	8,838	5,465	27
Pearl	13	1	3	53	...	...	72	1,483	2,684	00

TABLE—Continued.

DAVISS COUNTY.

NAME OF MINE.	EMPLOYED.			Days Worked.	ACCI- DENTS.		Kegs of Powder Used.	Tons Coal Pro- duced.	Wages Paid.	Improvements.
	Men Inside.	Mules.	Men Outside.		Fatal.	Non-Fatal.				
Cabel No. 4.....	53	9	7	123			824	24,418	19,614 51	
Cabel No. 9.....	118	13	6	231			1,443	69,334	44,549 34	
Montgomery No. 1.....	45	2	22	90				2,403	1,772 36	
Montgomery No. 2.....							384	3,459	2,160 75	
Montgomery No. 3.....	54	6	13	33			167	3,459	2,160 75	
Mutual.....	33	4	6	210			600	15,965	15,706 60	\$1 280 00
Hoosier.....	18	1	4	71				2,644	2,050 00	
Union.....								3,230	1,526 22	
Hawkins.....	28	4	5	135	1		120	25,930	31,009 84	
Wilson No. 4.....	25	2	3	225				13,635	7,378 38	
Stuffles No. 3.....										

FOUNTAIN COUNTY.

Silverwood No. 2.....	52	8	6	179		2	1,529	40,820	\$23,105 98	
Sturm No. 2.....	14	2	3	313			424	14,242	10,496 89	

GIBSON COUNTY.

Oswald.....	81	6	12	199		3	2,303	71,804	\$41,850 65	\$500 00
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GREENE COUNTY.

Island City.....	97	10	13	180		1		98,191	\$48,242 21	
Island No. 2.....	132	18	20					143,552	74,181 50	
Island Valley.....	48	4	6	172			692	39,440	25,440 41	
Fluhart.....	90	9	8	128			1,422	75,670	44,973 65	
South Linton.....	82	7	8	147		1	1,152	72,754	45,568 29	
Summit.....	107	13	12	173		8	2,164	124,351	70,162 74	
Templeton.....	97	6	11	87		2		107,098	58,747 88	
Summit No. 2.....						2				

KNOX COUNTY.

Bioknell.....	34	2	4	194	1		778	25,390	\$14,358 00	
Edwardsport.....	38	3	8	85			52	7,348	4,371 36	
Prospect Hill.....	19	3	5	242			523	15,208	13,055 31	

MARTIN COUNTY.

Tunnel.....	20	2	2	260			21	6,798	\$4,392 55	
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TABLE—Continued.

PARKE COUNTY.

NAME OF MINE.	EMPLOYED.			Days Worked.	ACCI- DENTS.		Kegs of Powder Used.	Tons Coal Pro- duced.	Wages Paid.	Improvements.
	Men Inside.	Mules.	Men Outside.		Fatal.	Non-Fatal.				
Brazil Block No. 12	89	6	9	218	.....	4	1,182	47,049	\$43,232 06	.....
Cox No. 3	86	13	20	246	.....	3	1,052	107,756	76,630 90	\$4,041 00
Lyford No. 2	127	11	15	183	.....	2	3,586	120,725	80,375 48	948 00
Mecca No. 1	44	5	7	280	.....	1	2,176	45,568	35,556 42	.....
Parke No. 8	80	5	11	257	.....	1	1,410	103,133	61,164 73	.....
Otter Creek	50	11	11	181	.....	2	1,306	37,516	32,915 34	.....
Superior No. 1	56	4	5	214	.....	.....	163	53,767	50,367 67	.....
Superior No. 2	134	7	8	247	.....	1	3,267	81,831	71,750 07	.....
Crawford No. 1	69	3	4	181	.....	2	171	36,656	30,815 80	.....
McIntosh No. 1	27	.....	2	146	.....	3	815	16,689	16,016 75	.....
McIntosh No. 3	46	3	6	196	.....	.....	1,306	31,316	26,934 07	.....
Lucia	78	5	6	221	.....	.....	3,268	62,560	43,515 17	2,998 00
Standard	74	5	5	17	.....	2	.....	57,234	46,365 00	.....

PERRY COUNTY.

Cannelton	34	3	6	153	.....	.....	.....	14,768	\$13,270 88	.....
Troy	19	2	2	209	.....	1	514	10,471	7,666 44	.....

PIKE COUNTY.

Hartwell	31	5	3	98	.....	.....	113	5,645	\$5,264 47	\$352 00
Ayrshire	121	22	12	77	.....	.....	2,199	43,928	44,610 63	.....
Blackburn	39	6	8	16	.....	.....	1,074	27,462	16,478 08	.....
Littles	99	10	11	132	.....	.....	2,007	52,389	26,266 33	.....
Carbon	31	3	3	67	.....	.....	456	14,879	7,133 23	.....
Woolley	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

SULLIVAN COUNTY.

Caledonia	44	3	4	196	.....	1	400	13,774	\$1,440 10	.....
Briar Hill	19	1	5	14	.....	.....	44	1,551	425 00	.....
Bunker Hill	12	2	3	108	.....	.....	79	2,405	1,692 76	\$27 00
Dugger	110	70	16	199	.....	3	1,113	95,588	46,190 28	.....
Star	94	13	21	93	.....	2	1,479	218,090	104,030 66	.....
Jumbo	120	20	.....	241	.....	5	1,217	161,112	88,362 64	200 00
Phoenix No. 1	151	12	20	219	.....	.....	1,656	177,281	66,061 31	.....
Hymers	47	5	11	214	.....	1	764	61,415	37,834 40	.....
Shelburn	66	8	10	236	.....	.....	1,199	65,696	38,738 73	.....
White Ash	33	2	3	75	.....	.....	570	19,655	13,234 00	.....
Ingleside	20	2	5	91	.....	.....	120	4,538	2,461 94	.....

TABLE—Continued.

VANDERBURGH COUNTY.

NAME OF MINE.	EMPLOYED.			Days Worked.	ACCI- DENTS.		Kegs of Powder Used.	Tons Coal Pro- duced.	Wages Paid.	Improvements.
	Men Inside.	Mules.	Men Outside.		Fatal.	Non-Fatal.				
Diamond	21	2	7	186	.....	1	574	13,485	\$12,041 72	.....
Union	22	3	5	247	.....	1	717	14,877	14,018 55	.....
Ingliside	54	10	9	25	.....	.....	1,873	40,597	3,469 81	.....
First Avenue	22	4	8	275	.....	.....	1,020	29,984	21,102 75	.....
Sunnyside	78	16	10	185	.....	.....	1,040	51,636	35,244 65	.....

VERMILLION COUNTY.

Brouillet's No. 4	120	9	8	267	.....	1	10,459	166,056	\$84,332 15	.....
Cayuga	16	2	3	210	.....	3	367	7,390	6,785 02	.....
Prince	135	12	11	244	.....	1	12,975	218,253	124,345 17	.....
Brouillet's No. 3 .....	.....	.....	.....	78	.....	.....	367	89,870	46,826 11	.....
Torrey No. 4	90	7	12	244	.....	2	4,628	123,940	82,358 21	.....
Buckeye	61	7	7	134	.....	1	2,225	56,483	30,800 14	.....

VIGO COUNTY.

Peerless	90	11	9	102	.....	3	.....	218,253	\$51,013 00	.....
Union	114	18	11	283	.....	1	.....	211,037	122,311 00	.....
Broadhurst	16	2	2	26	.....	1	590	10,495	6,670 91	.....
Ehrlich	55	5	7	265	.....	1	2,583	69,527	39,197 46	.....
Nickel Plate	61	7	9	196	.....	.....	1,397	62,270	47,342 11	.....
Hector	28	6	8	270	.....	.....	2,254	68,336	33,343 92	.....
Grant	75	9	9	153	.....	.....	3,450	80,372	51,516 60	\$2,400 00
Parke No. 10	100	11	12	170	.....	.....	1,342	149,460	66,720 93	.....
Brick Works	13	1	1	258	.....	.....	254	5,946	3,623 30	100 00
Vigo	24	3	3	66	.....	.....	86	3,025	1,863 25	.....
Ray	85	8	8	19	.....	.....	141	98,443	32,647 66	.....
Murray	28	3	4	23	.....	.....	65	2,270	937 00	100 00
Diamond No. 2	153	13	9	285	.....	1	.....	138,734	93,854 00	1,200 00
Klondyke	60	3	7	202	.....	1	1,337	43,483	28,446 97	.....

WARRICK COUNTY.

Star No. 1	38	4	7	249	.....	1	1,494	33,720	\$1,772 50	.....
Gough	14	3	3	97	.....	.....	271	67,036	2,928 30	.....
Air Line	12	1	3	.....	.....	.....	116	12,231	5,040 92	.....
Big Vein	30	7	6	109	.....	.....	427	25,880	7,485 55	.....
Oaledonia	19	2	3	63	.....	.....	114	5,155	3,006 51	\$221 00
DeForrest	17	.....	.....	.....	.....	1	315	6,199	2,472 32	.....

NOTE.

We call attention to the column of improvements, which amounts to \$22,227.71.

The following companies have put in electric haulage, which represents the greater part of the money expended for improvements:

1. The Brazil Block Coal Company, at their No. 1 and Cox No. 3 mines, two motors each of the improved third rail pattern.

2. Cabel & Co., of Daviess County, have also equipped their No. 9 mine with two motors of the third rail pattern.

The balance of the money expended for improvements has been spent for self-dumping cages, fans, scales, and in improving mines in various other ways.

MAPS.

It requires a good deal of urging on the part of the Inspector of Mines to secure a compliance with the law in regard to maps; but I think the dereliction in this respect is due more to want of attention than to a willful disregard of the law. I apprehend that the persons whose duty it is to furnish the information of this character do not realize its importance. I can not emphasize too strongly the necessity for complete and accurate maps. It furnishes a practical protection from encroachment upon abutting owners; it affords the Inspector a valuable source of reference and necessary information in considering the requirements and conditions of a mine, it being impossible to keep all the details of all the mines in one's mind, without such assistance; and it enables the Inspector to originate many suggestions as to the betterment of mines.

Maps are also invaluable in case of abandoned mines which have filled with water, as a guide in future mining operations in the vicinity of the abandoned mines; but to be of any value, in such case, it is highly necessary that the maps be absolutely correct. I quote briefly from my predecessor, Mr. Fisher, on that subject:

“A great expense and annoyance is occasioned in approaching an abandoned mine, where the extent of the worked-out territory is not known. The survey and map should be made by a practical surveyor, so that the accuracy of the survey could be relied upon. When a mine is worked out and abandoned all trace of it may disappear in a few years. In the case of mines working toward abandoned works, we have had several examples lately of the expense attending approaching them without a map, in one case a bore hole having been kept ahead of the workings for over 300 feet.”

Even this precaution does not render the work of the approach to the abandoned mine safe, as a stub of coal may have been left in the vacated mine, for some reason, and the hole penetrate the stub instead of striking the open space. We quote again from the above mentioned report:

“In another case, where apprehensions were felt as to the danger of breaking into an old mine, of which a map had been filed, a survey showed that the workings of the two mines were nearly 500 feet part, and work was continued for more than a year without the expense attending upon keeping a drill hole in advance. But this does not appeal to mine owners, as the benefit derived from it will be received by future operators. But a correct working map is a present benefit in many ways. It has a tendency to secure a more systematic working of the mine, to keep the workings in such a shape that the greatest possible amount of coal is finally recovered from the pillars and to prevent accidents from shot blowing through the pillars. In many instances, an accurate map of a mine would have prevented costly litigation over property injured by roof falling, on account of insufficient pillars being left to support it, and on account of trespassing on coal out of the proper lines. These maps are also of value to this office, in the assistance they render in understanding the monthly reports of mine bosses, and their use as a guide to the mines on visits of inspection. We have received a great benefit in these maps, and their value to a new incumbent of the office is inestimable.”

We fully approve everything stated in the above quotation, and much more could be said upon the subject. While writing this report I received a request from an owner of land adjoining one of our largest mines, asking that a survey be made of part of the mine adjacent to his land, stating that he believed the company owning such mine was removing coal from his land.

LIST OF MINES.

Table Showing the Names and Addresses of Persons and Corporations Operating Coal Mines in the State of Indiana, During the Year of 1899, with the Names of Mines in Each County.

CLAY COUNTY.

Names.	Addresses.	Mines.	Remarks.
Brazil Block Coal Co.	Brazil	Mine No. 1	Abandoned.
Brazil Block Coal Co.	Brazil	Gart No. 3	
Brazil Block Coal Co.	Brazil	Gart No. 5	
Brazil Block Coal Co.	Brazil	Mine No. 7	
Brazil Block Coal Co.	Brazil	Mine No. 8	
Brazil Block Coal Co.	Brazil	Mine No. 10	
Brazil Block Coal Co.	Brazil	Mine No. 11	
Briar Block Coal Co.	Chicago, Ill.	Briar Hill	
Chicago & Indiana Coal Co.	Terre Haute	Harrison No. 2	
Chicago & Indiana Coal Co.	Terre Haute	Harrison No. 3	
Coal Bluff Mining Co.	Terre Haute	Pratt	
Crawford Coal Co.	Brazil	Mine No. 3	Abandoned.
Crawford Coal Co.	Brazil	Mine No. 4	
Crawford Coal Co.	Brazil	Mine No. 5	
C. Ehrlich Coal Co.	Turner	Klondyke	
D. H. Davis Coal Co.	Knightsville	World's Fair	
Eureka Block Coal Co.	Terre Haute	Eureka No. 2	
Eureka Block Coal Co.	Terre Haute	Eureka No. 3	
Diamond Block Coal Co.	Chicago, Ill.	Diamond No. 3	
Goucher, McAdoo & Co.	Brazil	Monarch	
Jackson Coal and Mining Co.	Brazil	Brazil	
Jackson Coal and Mining Co.	Brazil	Dewey	
Andrew, Peter	Clay City	Markland	See Note 1. Abandoned.
Somer, Joseph	Staunton	San Pedro	
Zeller, McClellan & Co.	Brazil	Columbia No. 3	
Zeller, McClellan & Co.	Brazil	Columbia No. 4	
Zeller, McClellan & Co.	Brazil	Columbia No. 5	
Lancaster Block Coal Co.	Terre Haute	Rob Roy	
Brazil Mining Co.	Chicago, Ill.	Gladstone	
Crawford Coal Co.	Brazil	Louise	
Pyrah, Samuel	Brazil	Pyrah No. 3	
Diamond Block Coal Co.	Chicago, Ill.	Diamond No. 5	
Indiana Bituminous Coal Co.	Terre Haute	Silverwood No. 3	
Zeller, McClellan & Co.	Brazil	Cloverland	New mine. Abandoned.
Otter Creek Coal Co.	Brazil	Fairview	
Brazil Block Coal Co.	Brazil	Gart No. 11	
Cloverland C. & M. Co.	Cloverland	Pearl	

DAVISS COUNTY.

Cabel & Co.	Washington	Mine No. 4	Abandoned. See Note 3.
Cabel & Co.	Washington	Mine No. 9	
Daviess County Coal Co.	Montgomery	Mine No. 1	
Daviess County Coal Co.	Montgomery	Mine No. 2	Small mine. Small mine.
Daviess County Coal Co.	Montgomery	Mine No. 3	
Mutual Mining Co.	Cannelburg	Mutual	
Raglesville Coal Co.	Raglesville	Hoosier	
Stuffles, James	Raglesville	Mine No. 3	Small mine. Abandoned.
Washington Coal Co.	Washington	Hawkins	
Washington Coal Co.	Washington	Wilson No. 4	
Winklepleck, Jonas	Raglesville	Union	Small mine.

LIST OF MINES—Continued.

FOUNTAIN COUNTY.

NAMES.	ADDRESSES.	MINES.	REMARKS.
Indiana Bituminous Coal Co.....	Terre Haute	Silverwood No. 1	Abandoned.
Indiana Bituminous Coal Co.....	Terre Haute	Silverwood No. 2	New mine.
Silverwood Coal Co.....	Silverwood.....	Sturm	

GIBSON COUNTY.

Princeton Coal Co.....	Princeton.....	Oswald.....	
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GREENE COUNTY.

Island Coal Co.....	Indianapolis.....	Island City No. 1	
Island Coal Co.....	Indianapolis.....	Island No. 2.....	
Island Valley C. & M. Co.....	Linton.....	Island Valley.....	
Linton C. & M. Co.....	Linton.....	Fluhart.....	
South Linton Coal Co.....	Linton.....	South Linton.....	
Summit Coal Co.....	Bloomfield.....	Summit No. 1.....	
Summit Coal Co.....	Bloomfield.....	Summit No. 2.....	New mine.
Western Indiana Coal Co.....	Terre Haute.....	Templeton.....	

KNOX COUNTY.

Bicknell Coal Co.....	Bicknell.....	Bicknell.....	
Edwardsport Coal Co.....	Indianapolis.....	Edwardsport.....	See Note 4.
Prospect Hill Coal Co.....	Vincennes.....	Prospect Hill.....	

MARTIN COUNTY.

Wampler, F. M.....	Indian Springs.....	Tunnel.....	
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PARKE COUNTY.

Brazil Block Coal Co.....	Brazil.....	Cox No. 3.....	
Brazil Block Coal Co.....	Brazil.....	Brazil Block No. 12.....	
Brazil Block Coal Co.....	Brazil.....	Otter Creek.....	
Crawford Coal Co.....	Brazil.....	Mine No. 1.....	
McIntosh, I & Co.....	Brazil.....	Mine No. 2.....	
McIntosh, I & Co.....	Brazil.....	Mine No. 3.....	New mine.
Otter Creek Coal Co.....	Brazil.....	Mecca No. 1.....	
Parke County Coal Co.....	Rosedale.....	Parke No. 8.....	
Rock Run Coal Co.....	Brazil.....	Lucia.....	New mine.
Standard Coal Co.....	Terre Haute.....	Standard.....	
Wabash Valley Coal Co.....	Clinton.....	Lyford No. 2.....	See Note 5.
Zeller, McClellan & Co.....	Brazil.....	Superior No. 1.....	See Note 6.
Zeller, McClellan & Co.....	Brazil.....	Superior No. 2.....	

PERRY COUNTY.

American Cannel Coal Co.....	Cannelton.....	Cannelton.....	
Bergenroth Bros.....	Troy.....	Troy.....	

LIST OF MINES—Continued.

PIKE COUNTY.

Names.	Addresses.	Mines.	Remarks.
Cabel-Kaufman Coal Co.....	Cabel	Hartwell	
Ingle, D.	Oakland City	Ayrshire	
Potter & Johnson	Oakland City	Carbon	See Note 7.
The S. W. Little Coal Co	Evansville	Blackburn	
The S. W. Little Coal Co	Evansville	Little's	
The J. Woolley Coal Co	Evansville	Woolley	See Note 8.

SULLIVAN COUNTY.

Green Hill Coal Co	Sullivan	Green Hill	New mine.
Sexton & Crowder	Farnsworth	Bunker Hill	See Note 9.
Harder-Hafer Coal Co	Del Carbo	Star	
Hymera Coal Co	Hymera	Hymera	See Note 10.
Indiana & Chicago Coal Co	Dugger	Dugger	
Jackson Hill Coal and Coke Co	Eagle	Jumbo	
Dugger Co-operative Coal Co	Cass P. O.	Briar Hill	See Note 11.
New Pittsburgh Coal and Coke Co	Alum Cave	Phoenix No. 1	
Shelburn Mining Co	Shelburn	Shelburn	
Rainbow Coal and Mining Co	Farnsworth	Caledonia	See Note 12.
Sullivan Coal Co	Sullivan	Sullivan	Small mine.
White Ash Coal Co	Hymera	White Ash	

VANDEBURGH COUNTY.

Diamond Coal and Coke Co	Evansville	Diamond	
Evansville Union Coal Mining Co	Evansville	Union	
John Ingle Coal Co	Evansville	Ingleside	
Lozier, H. A.	Evansville	First Avenue	
Sunnyside Coal and Coke Co	Evansville	Sunnyside	

VERMILLION COUNTY.

Brouillet's Creek Coal Co	Clinton	Mine No. 3	See Note 13.
Brouillet's Creek Coal Co	Clinton	Mine No. 4	
Keller Coal Co	Clinton	Prince	
McClellan, Sons & Co	Clinton	Buckeye	
Torrey Coal Co	Voorhees	Torrey No. 4	
Cayuga Press Brick Co	Cayuga	Cayuga	

VIGO COUNTY.

Miller, A. F.	Macksville	Miller	Local.
Broadhurst, J. N. and G	Macksville	Broadhurst	Local.
Coal Bluff Mining Co	Terre Haute	Union	
Davis, Edward	Ehrmandale	Vigo	Small mine.
Ehrlich, Julius	Seeleyville	Ehrlich	
Grant Coal Mining Co	Burnett	Grant	
Lankford, William	Macksville	Larimer	Local.
Loughner Coal Co	Seeleyville	Hector	
Mackville Coal Co	Mackville	Murray	
Nevis Coal Co	Fontanet	Klondike	
Parke County Coal Co	Rosedale	Parke No. 10	
Terre Haute Brick and Pipe Co	Terre Haute	Brick Works	Local.
Vigo County Coal Co	Seeleyville	Ray	
Brazil Mining Co	Chicago, Ill.	Nickel Plate	
Grant Coal Mining Co	Burnett	Grant No. 2	New mine.

LIST OF MINES—Continued.

WARRICK COUNTY.

NAMES.	ADDRESSES.	MINES.	REMARKS.
Archbold, John.....	Evansville.....	Star Nos. 1 and 2.....	See Note 14.
Bartley, Patrick.....	Evansville.....	Chandler.....	
Caledonia Coal Co.....	Boonville.....	Caledonia.....	
DeForrest Coal Co.....	Evansville.....	DeForrest.....	Small mine.
Hall & Lawrence.....	Chandler.....	Air Line.....	
Kelley & Nester.....	Boonville.....	Gough.....	Small mine.
J. Woolley Coal Co.....	Evansville.....	Big Vein.....	

NOTES.

1. All work in the Goucher, McAdoo & Co. Mine is paid for by the day. The entire product of this mine is consumed at the Monarch Clay Works, located near the mine and owned by this company. Fire-clay is mined with the coal, and, for this reason, it is impossible to ascertain the cost of mining the coal. This will explain why the wages are not reported for this mine.

2. The Louise Mine in Clay County, formerly owned by the Weaver Coal Company, was sold in the month of May to the Crawford Coal Company.

3. The Daviess County Coal Company retired from business in March, and their mines, Montgomery No. 1 and No. 2, were leased by the Washington Coal Company in the month of April.

4. The Edwardsport Mine in Knox County was shut down on March 15 and remained idle until November 1. When operations were resumed at this time there had been several changes in the stockholders of the company, and the mine is now under the management of Mr. George Moore, of Indianapolis, one of the original stockholders of the company.

5. The Lyford No. 2 Mine was leased in the month of September by the Torrey Coal Company. The lease, however, extends only until April 1, 1900, when it is understood that a new company will take charge of the property.

6. The top vein in Superior No. 1 Mine, owned by Zeller, McClellan & Co., was abandoned in the month of May and the shaft sunk to the bottom vein.

7. The Carbon Mine in Pike County was sold in the early part of the year to the Johnson & Potter Company.

8. The Petersburg, owned by the J. Woolley Coal Company, was abandoned in the month of May, but was re-equipped and operations resumed in November by the same company.

9. The Bunker Hill Mine, in Sullivan County, formerly operated by Ladson, Carty & Smith, changed hands in October, and William Crowder, the owner of the mine, and W. H. Sexton, who was formerly connected with the Summit Coal Company, have assumed the management of the mine, and are equipping it with electricity.

10. The Hymera Mine was sunk to the lower vein in September, and the top vein was then abandoned.

11. Briar Hill Mine, in Sullivan County, which was operated during the early part of the year by the Lyonton Coal Company, changed hands in November, and the Dugger Co-operative Coal Company, the original owners, are now operating it.

12. The Bush Creek Mine, operated by Donald & Fogg, was leased in August by the Rainbow Coal Company, and its name was changed to the Caledonia Mine.

13. The shaft at Brouillet's Creek No. 3 Mine was sunk, in the early part of the year, to the bottom vein, and the top vein abandoned.

14. The Brizius Mine, in Warrick County, was leased in June by the John Archbold Coal Company and is now being operated by them as Star No. 2 Mine.

EXAMINATIONS.

Examinations of applicants for certificates of competency for mine and fire bosses and hoisting engineers at coal mines have been held at the following times and places and with the following results during the year, to wit:

DATES AND PLACES.	APPLICANTS.			PASSED.			FAILED.		
	M. B.	F. B.	H. E.	M. B.	F. B.	H. E.	M. B.	F. B.	H. E.
Terre Haute, May 23	13	.....	7	9	.....	5	4	.....	2
Evansville, September 6	7	1	3	6	.....	2	1	1	1
Terre Haute, December 8	18	.....	25	16	.....	19	2	.....	6
Brasil, February. (No record, see note.)									
Totals	38	1	33	31	.....	26	7	1	9

NOTE.

The Brazil examination, in February, was held by Mr. Fisher, before the expiration of his term. Upon examining the files in my office in the preparation of this report, I found that the record of the examina-

tion had never been turned over to me. I made diligent search among Mr. Fisher's papers, but was unable to find any record, or any notes from which I could give the result of this examination. It will be remembered that Mr. Fisher died very suddenly and unexpectedly. It is probable that those who took charge of his effects destroyed the papers relating to this examination, believing they were of no value.

CERTIFICATES OF COMPETENCY ISSUED DURING THE YEAR 1899.

MINE BOSSES.

	<i>Per cent.</i>
1. O. S. Stokesberry, Clinton.....	85
2. William Urwin, Knightsville.....	75
3. G. S. Patterson, Terre Haute.....	93
4. C. S. Roland, Hartwell.....	77
5. John W. Rees, Evansville.....	86
6. James Marsh, Ehrmandale.....	86
7. Nap. Harris, Asherville.....	76
8. Robert Fisher, Brazil.....	94
9. Michael H. King, Linton.....	90
10. J. S. Johnson, Oakland City.....	89
11. David Ingle, Oakland City.....	91
12. M. C. Randall, Linton.....	84
13. William T. James, Clay City.....	85
14. Alexander Ferguson, Clay City.....	77
15. Edward Dant, Montgomery.....	76
16. Johnson Peel, Cardonia.....	84
17. Reese Griffiths, Dugger.....	83
18. Edward Allias, Montgomery.....	81
19. William Rittenbery, Cloverland.....	78
20. W. H. Crawford, Dugger.....	91
21. Orion Long, Coal Bluff.....	81
22. Anthony Smith, Littles.....	78
23. W. B. Davis, Augusta.....	85
24. C. H. Marshall, Lyonton.....	77
25. Geo. Wm. Bird, Francisco.....	84
26. James Donald, Sullivan.....	89
27. Evan Price, Dugger.....	87
28. George Lindsay, Seelyville.....	77
29. E. H. Dugger, Dugger.....	88
30. John J. Eddy, Linton.....	80
31. Lander Blackburn, Francisco.....	86

HOISTING ENGINEERS.

1. E. W. Jackson, Clinton.....	95
2. William M. Exline, Sullivan.....	77
3. H. O. Cahill, Rosedale.....	86
4. John S. Brooks, Asherville.....	86

	<i>Per cent.</i>
5. Oliver F. Stephens, Sewall.....	75
6. William J. Bond, Farnsworth.....	75
7. Noah Hutchison, Lyonton.....	78
8. George R. Moore, Seelyville.....	75
9. Thomas J. Marsh, Linton.....	75
10. Wesley Morrison, Dugger.....	78
11. John Bledsoe, Eagle.....	79
12. Benjamine James, Cardonia.....	76
13. Arthur Dickenson, Linton.....	80
14. Lawrence Burgan, Mecca.....	78
15. E. F. McGranahan, Cloverland.....	85
16. Ferd B. Cochram, Farnsworth.....	76
17. Geo. O. F. Bryant, Seelyville.....	85
18. Ollie West, Linton.....	85
19. John Baird, Cardonia.....	78
20. William Redenbarger, Prairie City.....	81
21. Samuel J. Wilton, Carbon.....	78
22. Henry C. Bean, Linton.....	79
23. Braxton Walters, Farnsworth.....	81
24. William M. Taylor, Brazil.....	88
25. George W. Drain, Francisco.....	77
26. Ruthford B. Squire, Linton.....	88

My predecessor, speaking of the effect of examinations for certificates of competency for fire and mine bosses and hoisting engineers at coal mines, predicted that the interest aroused therein would raise the members of the craft in the estimation of the public, and also save from waste and loss a large percentage of our coal seams. I am glad to bear testimony to the truth of this prediction. In every part of the coal fields of this State may be seen evidence of their influence. They have acted as a powerful stimulus to investigation and study in this great branch of industry. It has aroused discussion, and caused the interchange of ideas and thought, while in nearly every mining community may be found a half dozen young men who are pursuing courses of study in some one of the numerous good mining schools through correspondence, which will result, no doubt, not only in good to themselves, but will be reflected in the mining industry of the future.

The result of this new awakening is not so perceptible, as yet, in the mines, for the reason that most of those now in operation were planned and developed before so much thought was given to the subject of mining; but considerable improvement has been made, even in the old mines. It is in the new mines recently opened, however, where the most progress may be seen.

In preparing the questions for examination, I have endeavored to make them as practical as possible, and, at the same time, to empha-

size those points most conducive to good mining. I herewith submit the lists of the questions used at the examination held at Terre Haute, May 23, 1899, together with some lists of answers to the same, which will give an idea of the character of the work done. There were no applicants for certificates of competency for fire bosses at this examination, and, therefore, no list of questions was prepared on that subject.

QUESTIONS FOR MINE BOSSES.

Questions for the examinations of applicants for certificates of competency to act as mine bosses at coal mines in the State of Indiana, held at Terre Haute, Ind., May 23, 1899:

1. What duties are imposed upon mine bosses by laws of Indiana?
2. A shaft sunk 150 feet to a vein of medium hard bituminous coal, with four feet of slate overlying it and two feet of fire-clay below it; describe plan of opening the mine; give width and length of bottom and thickness of shaft pillar, room and entry pillars; arrangement and construction of tracks; timbering; distance to cross entries and location of second opening?
3. In a certain mine the main air course and return are each 2,000 feet long. The air course is badly choked with fallen slate and the air is poor in all entries and working places, and the fan is being run to its full capacity. Name three ways in which the amount of air may be increased without putting in a larger fan.
4. What instruments are necessary to measure the amount of air circulation in a mine? Describe the use of each.
5. How would you discover the presence of fire damp in mines? Of white damp? Of black damp? What are the dangers to life and health from each kind?
6. Copy the sketch shown on the blackboard and show where you would place the doors and air bridges to ventilate the mine represented, as required by the laws of the State of Indiana. Use the signs as indicated on the board. (This may be answered in pencil.)
7. The main entry in a mine is driven in such a way that cross entries must be turned off an angle of 45 degrees. We wish to have 100 yards between the cross entries on a straight line. How far apart must the entries be turned on the main entry?
8. If you were in charge of a mine in which a number of rooms and entries were generating considerable quantities of explosive gas, how would you keep the faces of the working places clear while driving from one break-through to another?
9. What is a squeeze in a coal mine? How are squeezes produced or brought on? How may they be stopped after they have started?
10. What conditions bring about fires in mines? How would you prevent fires in mines? How would you extinguish fires in either coal or gob?

11. If your fan was running at a speed of fifty revolutions per minute and giving 20,000 cubic feet per minute, and you wish to increase your quantity to 34,000 cubic feet, at what speed would the fan have to be run?
12. How many tons of mine-run coal can be taken out of a six-foot vein of coal before a second outlet must be provided as required by law?
13. In sinking a shaft 9x14 and 150 feet deep we have 20 feet of clay and hard-pan, 25 feet of quicksand and 105 of sand, shale and gray slate. Describe your method of sinking the shaft, the different sizes and amount of timber required to timber it, you to select your own sizes of timber.
14. Name the results of bad drainage under different circumstances and conditions found in the mines of Indiana.
15. What particular points should receive the mine boss's attention when visiting men at their working places and making rounds of the mine?
16. Each applicant will be required to show by a practical demonstration the use of the anemometer, etc., in the measurement of air currents. (These will be taken at intervals during the day.)
17. Name the different safety appliances in and about coal mines that should be under the general supervision of the mine boss.
18. In a mine with a gray shale roof that cuts badly on the entries describe your method of timbering an eight-foot entry, size of timber to be used, method of framing and setting the same.
19. In entering a mine after an explosion, to rescue persons, what course would you pursue to repair the mine and reach the working places to recover dead bodies, with the greatest safety to the rescuing party?
20. What accidents occurring in the mine from shot firing may be lessened by proper precautions, and what precautions would you suggest in this line?

QUESTIONS FOR ENGINEERS.

Questions for the examination of hoisting engineers at Terre Haute, Indiana, May 23, 1899:

1. What experience have you had in handling steam and machinery? Where have you been employed in this line?
2. What is the law of Indiana in regard to persons who may have charge of hoisting engines at coal mines?
3. What precautions are required by law, in Indiana, to be taken about the hoisting machinery and shafts to add to the safety of persons entering or leaving mines?
4. What changes would be necessary in the arrangement of a boiler furnace built to burn lump coal, to fit it to burn slack under the boilers?
5. What causes boiler walls to crack? How is this provided against in setting boilers?
6. Name three classes of boilers that are used at coal mines in Indiana. Which one of these do you prefer? Give reasons for your preference?
7. The shell of a plain cylinder boiler is 42 inches in diameter and 23 feet long, and is made of single-riveted steel plates one-fourth inch thick; what pressure can it carry safely?
8. What pressure would a two-flue boiler of the same dimensions and construction carry?

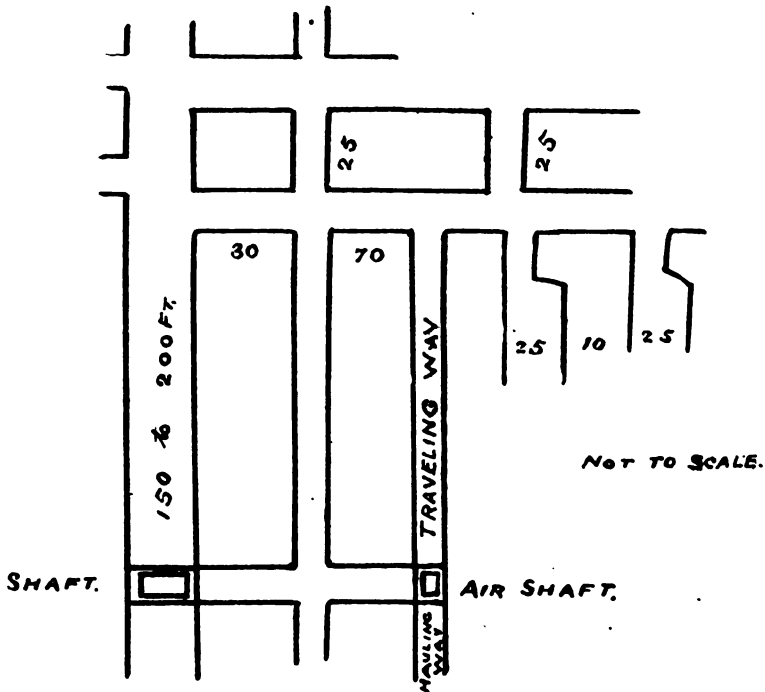
9. Describe a brake to be used on a hoisting rig. (If you can make your description plainer by a sketch, do so.)
10. What are the effects of too little water in a boiler? Of too much?
11. Why is cast iron used in some parts of an engine, wrought iron in other parts, and steel in other parts?
12. Name the different openings, pipes and valves through which steam passes from the boiler until it is finally exhausted, and give the effect produced by it at each step of its course.
13. How does the reverse link change the direction in which an engine runs?
14. How is the horizontal motion of the piston made to raise the cages perpendicularly? (Give all the mechanism that is used to produce the changes of direction of the motion.)
15. What parts of the hoisting machinery at a coal mine need lubricating? What kind of oil should be used for this purpose?
16. How is water forced into a boiler against the same pressure as is on the steam piston of the pump?
17. What are the usual effects of mine water on pumps and pipes? On boilers when used to make steam in them?
18. What is the weight per square inch on the bottom of a column of water 269 feet high?
19. What pressure of steam would be necessary at the boiler to raise and discharge water to this height, making due allowance for loss of pressure and friction of the water in the pipes? (Give the reasoning by which you arrive at your conclusion.)
20. How would you test your safety valve to learn whether it is reliable?

ANSWERS OF G. S. PATTERSON OF TERRE HAUTE, TO QUESTIONS FOR MINE BOSSES.

1. The mine boss shall examine all places where men are at work, or should be, at least every alternate day, and see that such places are safe, and, if they are not safe, have them put so. He shall measure the air every week at inlet and outlet and face, and report measurements at first of month to the Mine Inspector, with which report shall be given number of men and mules working and number of days worked. He shall see that the men are supplied with props and that all traveling ways are safe. When he shall be notified of an unsafe place, he shall give the informer a receipt for same and permit no one to enter the place until it is made safe. He shall look after the general safety of the men and see that safety appliances, under his jurisdiction, are in good order.

2. The bottom should be so arranged that the cars can be easily handled, and the dip of the seam and thickness of coal would determine the amount of bottom to be taken up or top brought down. In this case, especially if the bottom of the shaft is wet, it would be advisable to remove the clay. The main entries are to be driven straight from the bottom of shaft, and should be at least 16 feet wide for the turn-outs, which should extend to first cross entries. This turn-out and bottom of shaft should be securely timbered by cross bars let into the ribs, or, preferably, by means of steel eye beams, if the top is at all likely to break. The tracks

should be so managed that the loaded cars will run readily to the shaft and the empty ones be easily taken in the opposite direction. This can be best accomplished by having the tracks grade as shown in the sketch. There should be six feet in clear on turn-out. The following sketch shows general plan to first cross entry. The size of room, pillars and width of rooms, might vary from this according to top.



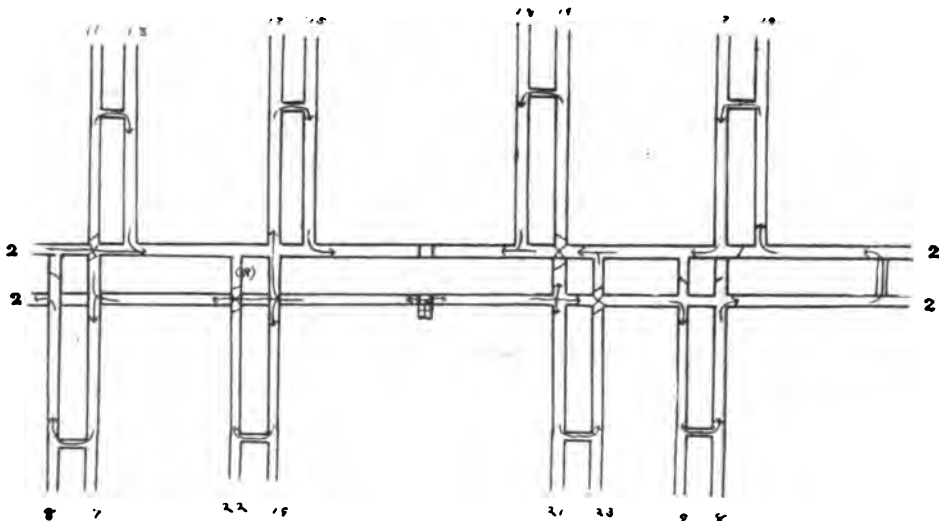
3. First, clean up the fallen slate; second, divide the air in splits; third, close up all leakages.

4. An anemometer, a watch and a tape. A section of the entries is measured to get the area. The anemometer registers the velocity of the air in feet, the time being taken by the watch. The anemometer is held in the current for several minutes, a portion of the time in different parts of the cross section, the time being accurately taken by the watch; if possible, the observer standing out of the current. The registration of the anemometer divided by the time number of minutes gives the velocity in feet per minute, which multiplied by the area of cross section in feet gives the number of feet per minute.

5. The presence of fire damp is indicated, frequently, by the hissing noise made in issuing from the coal. Its presence is shown on the naked light by elongation of the flame. It is only safely tested for by means of a safety lamp. White damp is indicated on a naked light by a peculiar brilliancy of the flame and a blue tip. Black damp is shown by the fact

that it does not support combustion, and lights grow dim and finally go out. Fire damp is dangerous on account of its violent explosive properties. White damp is also violently explosive and is also dangerous if inhaled. Black damp will not support combustion nor life, and a person subject to it in breathing is smothered. All of these, even in minute quantities, are detrimental to health, inasmuch as they take the place of so much pure air needed.

6. Brattices may be used where some doors are depending on haulage



roads. A cross-cut between entries would do away with doors at overcasts.

7. The distance on the main entry will be the hypotenuse of a right-angled triangle of 45 degrees. The hypotenuse equals the square root of sum of squares of the two sides and the two sides of a 45-degree triangle are equal; hence, distance equals the square root of the square of 100 plus the square of 100 equals 1,414 yards.

8. I should keep a brattice up as near as need be to the face from the last break-through, so as to turn the air directly to the face.

9. A squeeze is a general subsidence of the overlying strata crushing the pillars, and at times causing the bottom to heave. They are brought on usually by leaving insufficient pillars and failing to break the top. They are stopped by heavy timbering on the margin of the squeeze, and by getting a break in the roof to relieve the pressure.

10. Gob fires are started by spontaneous combustion, caused, largely, by decomposition of iron pyrites, assisted by oxidation of fine coal. The fire will be found where the ventilation is sluggish or none at all.

Fires are also started by explosions, ignition of a gas feeder, or by carelessness in handling naked lights about dry timber, feed, etc. Fires

can be avoided by great care in handling lights where fire is liable, and by keeping the ventilation current strong, and, in dusty mines, by periodically wetting down the roads.

To extinguish a fire, if it is small and easily approached, it can be wet and loaded out in cars. If too great for this, hose should be conducted to it and the fire extinguished with water. And if this be not successful, flooding that part of the mine may be necessary, or the fire can be isolated by building air-tight dams about it. In fighting any fire, care should be taken to keep the fresh air up with the working force. In all cases, also, the fresh air should be kept from the fire.

11. Assuming the increase of speed will increase the velocity we have:

$$20,000 : 24,000 :: 50 : X$$

$$\frac{34,000 \times 50}{2,000} \text{ equals } 85 \text{ rev.}$$

12. The law requires a second opening after 5,000 square yards have been excavated. In a six-foot seam this would be $5,000 \times 6 = 30,000$ cubic feet; at 77 pounds per cubic foot $= 2,310,000$ pounds $= 1,155$ tons.

13. Put on ground at proper level for the top heavy sills extending on all four sides for a front bearing. These should be as large as can reasonably be obtained and not less than 12x12 inches; they will act as the top of shaft and support the head frame.

Sinking can be started from this with curbing of 2½ inches or 3x6 inches, laid flat and spiked, breaking joint at the corners by alternate lapping. These should be followed down with the buntons being put in every four feet. The buntons to be 6x8 inches. To go through the quicksand, poling or piling should be used all around the shaft and kept ahead of the excavation, the curbing following closely and being suspended from that above.

If the sand, shale and slate are sufficiently hard after getting away from the quicksand and casing the water, the shaft can be timbered by square sills four or five feet apart with corner posts at the four corners. These timbers should be 6x8 inches, except corner posts, which may be 6x6 inches. Care should be taken to keep the shaft plumb by means of plumb lines and the four corners.

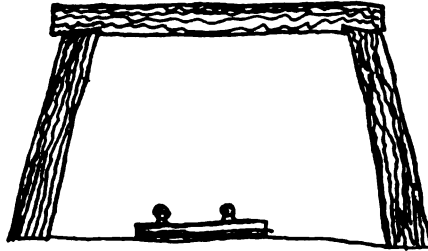
14. Bad drainage causes roads to become muddy and wet, softens the bottom, washes oil from wheels and makes hauling difficult. In case of a hard bottom, the roads will not be as bad as with fire clay, but they will become more or less muddy and cause trouble to the roads. Working places are also affected by failure to drain the main roads, and the tonnage thus affected.

15. He should see if the place is properly timbered, that they are driven in proper direction; that the air is sufficient; that they are throwing refuse into gob and not loading it; also that shots are properly placed. He should know all the features of the room so as to call the attention of the men to any dangerous condition.

16. (Anemometer test.)

17. Safety catches on cages, gates at top of shaft and at upper seams when two are working, covers on cages, lamps within ten feet of shaft at upper seam. If he has charge of the machinery, he should look after the brake or drum and indicator to engine.

18. This should be timbered with not less than 10-inch timber in sets three to four feet apart. They should be set and framed, as in sketch, with a slight spread. When the coal is hard and will stand it, the cross timbers can be let into ribs. This should be close lagged before the air has much chance at it.



19. After an explosion, restore the circulation as soon as possible. The rescuing party should proceed with caution, keeping the fresh air with them, repairing brattices and doors as they advance, and putting in brattices when necessary.

20. An accident from a shot supposed to miss fire can be prevented by the miner remaining away longer from the shot after it seemingly fails. Accidents from shots going off while men are passing can be largely avoided by the plan of rotation of shots, all men being past the point where the fire occurs. Blown out shots may be avoided largely by not putting in such a heavy charge, and seeing that the line of least resistance is not too great for the shot. Practically all of the precautions against these accidents in blasting are in the hands of the miners themselves, and they should be urged to use them.

ANSWERS OF WILLIAM E. JACKSON OF CLINTON, IND., TO QUESTIONS FOR
HOISTING ENGINEERS.

1. I have had quite a varied experience—three years as fireman, 19 months as hoisting engineer. I have been employed at Tracey City, Tenn., as fireman; Central City, Ky., as engineer; Island, Ky., as engineer and fireman; Clinton, Ind., as fireman; Linton, Ind., as fireman, at Island City Shaft.

3. (1) That the engineer shall be competent. (2) That safety catches shall be applied to the cages to hold the cages or check the force of their fall in case of breakage of rope or engine. (3) That there shall be in effect a fixed code of signals with signal bells, one at the bottom of the shaft and one in the engine room. (4) That no more than six men shall be on a cage at any one time; also, that no man shall come up or go down the shaft except when both cages are empty. (5) That the drum shall have a brake attached, with sufficient power over the drum to hold the cages in case of breakage or slip of machinery.

4. If the furnace was built with sufficient draught, as it should be, it would require little change, except in the grate bars, the area of which

ought to be enlarged to allow more draught to pass through, and the bridge walls ought to be lowered a little to allow the increased volume caused by the enlargement of the grate bar area. The grate bars of the single straight screen bar type are preferable to the sectional bar when burning slack.

5. The cause of boiler walls cracking is the expansion and contraction of the walls and the boiler's shell. I think the best method of setting boilers to prevent the walls from cracking is to leave an air passage in the walls, when building, to keep the walls as cool as possible, and, when complete, brace the sides of the wall and tie the braces at the top and bottom with iron rods, and to relieve the pressure on the walls by the expansion of the boiler shell sidewise. Hang the boiler to cross beams above, by means of wrought iron rods so that when the boiler is heated and expands, the rods will expand a little, allowing the shell to lower a little, saving the walls from strain. When the temperature is lowered, the hangers contract, thus raising the shell, which contracts proportionately, thus resuming its normal condition and former position.

6. The plain cylinder boiler, the cylinder flue boiler and the return flue boiler. I prefer the return flue boiler, because of the greater amount of heating surface contained in the return flue boiler over the other kind, thus making it easier to generate steam.

7. A plain cylinder boiler, 42 inches in diameter, made of one-quarter-inch steel plates, single riveted, 23 feet long, will safely carry 107 pounds. [Should have given the formula.—Inspector.]

8. A two-flue boiler of the same construction will carry 107, for the flues do not increase or diminish the strength of the shell. The above boilers would carry, while in perfect condition, 120 pounds, which is one-sixth of bursting strain.

9. A brake to be used on a hoisting rig should be composed of a circular band around the drum, with both ends hinged to a lever, so when the engineer presses down on the lever, it will draw one end of the strap or band up and the opposite end down, thus causing the strap or band to close tightly upon the drum. It should be so arranged that the engineer can use the brake with his foot.

10. The effects of too little water in a boiler are, to cause an explosion if any more cold water is pumped into the boiler while hot, or to burn the boiler and cause it to collapse. The effects of too much water in the boiler are, to cause the water to run from the boiler to the cylinder, thus causing the exhaust to choke. Sometimes it bursts the cylinder head out, and is liable to do a great amount of damage to the machinery by jerking it or stopping it suddenly. It also takes up the steam room in the boiler, thus decreasing the normal supply of steam.

11. Cast iron is used in some parts of an engine because it is not flexible. Wrought iron is used in other parts because it is tough and will bend before it will break. Steel is used because of its strength and durability and smoothness of surface.

12. Steam first passes through the main steam pipe to the cutoff valve, thence to the throttle valve, thence to the steam chest, thence through the slide valve openings to the cylinder. The effect, when it enters the cylinder, is to force the piston head back to the opposite end

of the cylinder from which it entered. This causes one-half revolution of the driving crank and shaft. Then the slide valve opening, through which the steam entered the cylinder, is closed to the line steam and opened so the dead or exhaust steam can return through it and enter the exhaust pipe, thence to the open air.

13. When the reverse link is raised or lowered, as the case may be, it forces the slide valve back or forward, thus closing the openings that were closed before the link was moved, thus forcing the piston in the opposite direction to that which it would have moved had the link remained where it was. This produces reversed motion to all the machinery.

14. The piston is attached to what is known as a connecting rod, and the connecting rod is attached to the crank pin on the crank, which is attached to the driving shaft. By the back and forward motion of the piston, the connecting rod being hinged to the piston crosshead, and also to the crank, by means of the crank pin, one end of the rod raises and lowers with the rotary motion. The drum is attached to the driving shaft, from which it gets its motion. Around the drum is coiled a rope, which runs in a grooved pulley at the top of the head frame. Then, by the rotary motion of the drum, the rope is coiled around it, and thus draws up the other end, which is attached to the cage, and thus hoists the cage. Then, to lower the cage again, the engine must be reversed. To the driving shaft is attached two small cranks, called eccentrics. To these are attached a rod to each crank or eccentric, called cam rods, and are attached at the other end to the reversing link, one rod to each end of the link. The link is moved back and forward by the motion of the cam rods, which, in turn, are propelled by the throw of the eccentrics. The method of reversing the motion of the engine is explained in answer to question No. 13.

15. The parts of a hoisting engine that need lubricating are, the steam chest and cylinder, the crosshead guides, the wrist pin, the crank pin, all the shaft and journal bearings, the reversing link, the eccentrics, the steam cutoff valve crosshead. Engine oil should be used on all parts of machinery except in the chest and cylinder; cylinder oil only should be used in them.

16. Water is forced in a boiler against the same pressure as the steam pressure on the steam piston by the steam piston head being larger than the water piston head.

17. Mine water rusts the pumps; that is, where it touches the iron, it completely eats up the pipes. When used in boilers to make steam it corrodes the shell and generally causes the shell to blister and burn just over the fire.

18. If the column is 269 feet the pressure would be 154 pounds, nearly. [Should have given formula.—Inspector.]

19. It will require 154 pounds, or the same force, to cover the resistance.

20. I would test my safety valve by the steam gauge, if it was a spring valve; but if it was the lever safety valve, I would weigh the weight and then figure its position.

The following certificates of service have been issued during the year:

MINE BOSSES.

- | | |
|--------------------------------|-------------------------------|
| 1. William Shepard, Boonville. | 6. John Ingle, Evansville. |
| 2. Louis Stock, Boonville. | 7. James Cuthbertson, Brazil. |
| 3. John Summers, Carbon. | 8. William Willson, Sullivan. |
| 4. Newton Braun, Brazil. | 9. William Schank, Ehrmandale |
| 5. Richard Moore, Clinton. | 10. Clemens Haffey, Carbon. |

HOISTING ENGINEERS.

- | | |
|----------------------------------|---------------------------------|
| 1. G. A. McWelty, Turner. | 8. Clarence M. Rogers, Burnett. |
| 2. Frank Wilkerson, Evansville. | 9. Arthur Shelburn, Delcarbo. |
| 3. James T. Allen, Terre Haute. | 10. Edward Sherkie, Clinton. |
| 4. Charles F. Somers, Staunton. | 11. Fred Hoff, Brazil. |
| 5. John Crosby, Brazil. | 12. M. D. West, Staunton. |
| 6. Carlos D. Wilson, Evansville. | 13. Daniel Grimm, Brazil. |
| 7. B. F. Taylor, Burnett. | 14. Daniel Webster, Coal Bluff. |

FIRE BOSSES.

- | | |
|----------------------------------|-----------------------------|
| 1. John Crosby, Shelburn. | 2. John D. Price, Shelburn. |
| 3. Andrew Winterbottom, Clinton. | |

INDIANA MINES.

I give below a list of mines which were in active operation on January 1, 1900, the person in charge of each mine, as shown by the December (1899) reports of the mine bosses:

CLAY COUNTY.

MINE.	MINE Boss.	ADDRESS.
Brazil Block No. 1	John Bolin	Brazil.
Monarch	James King	Brazil.
Diamond No. 3	Jas. Cuthbertson	Brazil.
Gladstone	W. P. McQuade	Brazil.
Brazil Block No. 11	Martin Navin	Diamond.
Brazil Block No. 8	Henry Payne	Brazil.
Pratt	H. W. Jenkins	Perth.
Eureka No. 2	W. T. Hopkins	Carbon.
Eureka No. 3	John Quigley	Carbon.
Rob Roy	Allen Walker	Brazil.
Dewey	John Cox, Sr.	Brazil.
Gart No. 5	A. Gilmour	Cardonia.
Gart No. 3	Geo. Doidge	Brazil.
Crawford No. 4	Samuel Lindsey	Hoosierville.
Columbia No. 5	M. Hoffman	Asherville.
Columbia No. 4	T. Thompson	Hoosierville.

INDIANA MINES—Continued.

CLAY COUNTY—Continued.

MINE.	MINE BOSS.	ADDRESS.
Louise.....	Grif. Howell.....	Center Point.
Crawford No. 5.....	Walter Knox.....	Asherville.
Briar Hill.....	Robert Bennie.....	Clay City.
Markland.....	Peter Andrew.....	Clay City.
Harrison No. 2.....	Chas. Nash.....	Clay City.
Harrison No. 3.....	Chas. Nash.....	Clay City.
Klondyke.....	J. Ehrlich.....	Staunton.
Silverwood.....	William Myers.....	Turner.
San Pedro.....	Ed. Somers.....	Staunton.
Crawford No. 3.....	Wm. Printz.....	Brazil.
Diamond No. 5.....	James Cuthbertson.....	Brazil.
Brazil Block No. 10.....	Wm. McBeth.....	Perth.
Cloverland Mine.....	Geo. Donie.....	Brazil.
Pearl.....	Robt. Jenkins.....	Brazil.

DAVISS COUNTY.

Cabel No. 4.....	A. Kocher.....	Washington.
Cabel No. 9.....	A. Kocher.....	Washington.
Wilson's No. 4.....	J. Teverbaugh.....	Washington.
Mutual.....	D. W. Davis.....	Cannelburg.
Hoosier.....	A. W. Stuckey.....	Raglesville.
Union.....	A. W. Stuckey.....	Raglesville.
Stuffles No. 3.....	W. A. Jacobs.....	Raglesville.
Hawkins.....	Thomas Harris.....	Washington.
Montgomery No. 2.....	Ed. Dant.....	Montgomery.
Montgomery No. 3.....	Thos. Small.....	Washington.

FOUNTAIN COUNTY.

Sturm.....	J. S. Tiley.....	Silverwood.
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GIBSON COUNTY.

Oswald.....	J. C. Anderson.....	Princeton.
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GREENE COUNTY.

Island No. 1.....	S. C. Risher.....	Linton.
Island No. 2.....	J. S. Newport.....	Linton.
Island Valley.....	Joseph Fennel.....	Linton.
Fluhart.....	Thomas McQuade.....	Linton.
South Linton.....	N. C. Randall.....	Linton.
Summit No. 2.....	Earnest Dugger.....	Linton.
Templeton.....	John A. Templeton.....	Linton.
Summit.....	Frank Lockhart.....	Linton.

INDIANA MINES—Continued.

KNOX COUNTY.

MINE.	MINE BOSS.	ADDRESS.
Prospect Hill	W. R. Scott.....	Vincennes.
Bicknell	R. M. Freeman	Bicknell.
Edwardsport	Charles Harding	Edwardsport.

MARTIN COUNTY.

Tunnel	F. M. Wampler	Indian Springs.
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PARKE COUNTY.

Parke No. 8	George Mitch	Rosedale.
Cox No. 3	James Burt	Coxville.
Mecca No. 1	James Skene	Mecca.
Lucia	F. J. Urbain	Mecca.
Lyford No. 2	Wm. Wilson	Lyford.
Brazil Block No. 12	Robert J. Wallace.....	Diamond.
Standard	James Baxter	Brazil.
Superior No. 2	Jno. Chesterfield, Sr....	Brazil.
Superior No. 1	Geo. Myers	Brazil.
McIntosh No. 1	Samuel Holden	Brazil.
McIntosh No. 3	Jno. Chesterfield, Jr....	Brazil.
Otter Creek	John Bolin	Carbon.
Crawford No. 1	Henry Schlatter.....	Carbon.

PERRY COUNTY.

*Cannelton	Geo. W. Briggs	Cannelton.
Troy	H. L. Williams	Troy.

PIKE COUNTY.

Woolley	H. T. Brewis	Petersburg.
Blackburn	John R. Willey.....	Petersburg.
Little's	Anthony Smith.....	Littles.
Carbon	C. C. Potter	Sophia.
Ayrshire	Dave Ingle, Jr.....	Ayrshire.
Hartwell	C. C. Roland.....	Cable.

SULLIVAN COUNTY.

Jumbo	G. H. Sargent	Eagle.
Hymera	Sam Campbell.....	Hymera.
Phoenix	Joseph Peters	Alum Cave.
Star	S. Woolley	Del Carbo.
Shelburn	C. C. Hall	Shelburn.
Sullivan	David Harrison.....	Sullivan.
Caledonia	Thomas Thomas	Farnsworth.
Bunker Hill	H. W. Sexton	Farnsworth.
Briar Hill	James James	Dugger.
Ingleside	Wm. McCloud	Dugger.
Dugger	John G. Griffith.....	Dugger.
White Ash	Wm. Britton	Hymera.
Green Hill	John Beck	Sullivan.

INDIANA MINES—Continued.

VANDERBURGH COUNTY.

MINE.	MINE BOSS.	ADDRESS.
Union.....	P. Schultheis.....	Evansville.
Diamond.....	G. Bonenberger.....	Evansville.
First Avenue.....	Frank Guenther.....	Evansville.
Sunnyside.....	C. H. Baetz.....	Evansville.
Ingleaide.....	Alex Maule.....	Evansville.

VERMILLION COUNTY.

Buckeye.....	Wm. Chesterfield.....	Clinton.
Brouillet's Creek No. 3.....	Thos. Clements.....	Clinton.
Brouillet's Creek No. 4.....	Stewart Shirkie.....	Clinton.
Prince.....	John Mushett, Jr.....	Clinton.
Torrey No. 4.....	Geo. Davis.....	Voorhees.
Cayuga.....	R. M. Irving.....	Cayuga.

VIGO COUNTY.

Peerless.....	G. R. Anthony.....	Fontanet.
Union.....	James Johnson.....	Fontanet.
Diamond No. 2.....	Thomas Gregory.....	Fontanet.
Grant Nos. 1 and 2.....	James Devonald.....	Burnett.
Nickel Plate.....	Claude Peck.....	Ehrmandale.
Klondyke.....	John Bland, Jr.....	Ehrmandale.
Ray.....	George West.....	Seelyville.
Ehrlich.....	H. B. Ehrlich.....	Seelyville.
Hector.....	William Grey.....	Seelyville.
Parke No. 10.....	Jeff. Ladson.....	Heckland.
Brick Works.....	Robert B. Bieler.....	Macksville.
Murray.....		Macksville.
Broadhurst.....	John F. Erwin.....	Macksville.
Larimer.....		Macksville.
Vigo.....	John Barker.....	Ehrmandale.

WARRICK COUNTY.

Star No. 1.....	Geo. F. Archbold.....	Newburg.
Air Line.....	T. B. Hall.....	Chandler.
Chandler.....	Patrick Bartley.....	Chandler.
Big Vein.....	William Woolley.....	Boonville.
Caledonia.....	E. P. Hargrooves.....	Boonville.
Gough.....	Wm. Kelly.....	Boonville.
Star No. 2.....	Geo. Archbold.....	Newburg.

A NEW ELECTRIC MOTOR.

A Terre Haute, Ind., firm has recently introduced a motor for hauling coal and other material, designed to work on a new traction principle.

The motor complete weighs two tons, and can be made any size, larger or smaller. It receives the tractive power from friction wheels clamped against and rotated along the sides of a center or third rail. These wheels are rotated through suitable gearing by an armature which is supplied with the current by a trolley which runs along a trolley wire inserted in a groove in the sides of the center rail. The current is returned through the track rails, laid with fish-plates and bonded.

This motor is in successful operation in the Brazil Block Coal Company's No. 1 and Cox No. 3 mines, Brazil, Ind., and Cabel & Co.'s No. 9 Mine, Washington, Ind.; also in the Kellyville Coal Company's No. 3 Mine, Grape Creek, Ill.; and also the Catlin Coal Company's mine, Catlin, Ill.

The grades in these mines are variable. In the Cabel & Co.'s mine the motor moves a large trip of empties up a long hill with a six per cent. grade and down a slight grade farther in; it then brings out the same number of loaded cars and loads them back coming down the hill to the shaft.

In the Brazil Block Coal Company's No. 1 Mine it brings a large trip of loaded cars up grades from two to eight per cent. and holds back the empties going in. At Cox No. 3 trips of 15 to 25 cars are handled on grades from one to four per cent. some places against the loads and sometimes against the empties. In the Kellyville and Catlin mines the grades are from one to four per cent.

TABLE OF FATALITIES BY YEARS.

YEAR.	Em- ployes.	Tons of Coal.	Fatalities.
1879	3,459	1,196,490	.....
1880		1,550,375	.....
1881	4,567	1,771,536	10
1882		1,990,000	.....
1883	5,403	2,560,000	11
1884	5,716	2,260,000	9
1885	6,502	2,375,000	7
1886	6,406	3,000,000	7
1887		3,217,711	.....
1888	6,685	3,140,979	17
1889 .....			.....
1890	6,550	3,791,211	5
1891	6,975	3,819,600	5
1892	7,600	4,408,417	19
1893	7,431	4,358,897	22
1894 .....			.....
1895	7,885	4,202,084	23
1896	7,112	4,068,124	28
1897	7,984	4,088,100	16
1898		5,146,920	19
1899	7,366	5,864,975	15

NOTE.—Where blanks occur there was no report.

LEGISLATION.

The following laws have been enacted for the special benefit of mine workers since the last report of the Inspector of Mines:

IMPURE MINERS' OIL.

Act approved March 3, 1899, p. 246.

Section 1. Be it enacted by the General Assembly of the State of Indiana, that only a pure animal or vegetable oil, or other oils that shall be as free from smoke as a pure animal or vegetable oil, and not the product or by-product of rosin, and which shall, on inspection, comply with the following list, shall be used for illuminating purposes in the mines of this State: All such oil must be tested by the State Supervisor of Oil Inspection or his deputies at 60 degrees Fahrenheit. The specific gravity of the oil must not exceed 24 degrees Tagliabue. The test of the oil must be made in a glass jar one and five-tenths (1 5-10) inches in diameter by seven (?) inches in depth. It the oil to be tested is below 45 degrees Fahrenheit, and should the oil be above 45 degrees and below 60 degrees Fahrenheit, it must be raised to a temperature of about 70 degrees Fahrenheit, when, after being well shaken, it shall be allowed to cool gradually to a temperature of 60 degrees Fahrenheit before finally being tested. In testing the gravity of the oil the Tagliabue hydrometer must be, when possible, read from below, and the last line which appears under the surface of the oil shall be regarded as the true reading. In case the oil under test should be opaque or turbid, one-half of the capillary attraction shall be deemed and taken to be the true reading. When the oil is tested under difficult circumstances an allowance of one-half degree may be made for possible error in parallax before condemning the oil for use in the mine. All oil sold to be used for illuminating purposes in the mines of the State shall be contained in barrels or packages, branded conspicuously with the name of the dealer, the specific gravity of the oil, and the date of shipment.

Sec. 2. Any individual, firm, corporation or company that sells or offers for sale any other oil other than provided in section 1 to be used for illuminating purposes in coal or other mines of the State, or the individual, firm, corporation, company or person having in charge the operation or running of any mine, who permits the use in his or their mine any oil for illuminating purposes other than that provided for in section 1, or any employe in any mine of this State, who uses, with a knowledge of its character, a quality of oil other than is pro-

vided for in section 1, shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be fined in any sum not less than five (5) dollars nor more than twenty-five (25) dollars.

SANITARY.

Act approved March 4, 1899, p. 382.

Section 1. Be it enacted by the General Assembly of the State of Indiana, That there be no shooting, or blasting of any kind allowed in the mines of the State in working hours: Provided, In cases of opening up a new mine, which contains not over twenty (20) employes, and not over one hundred (100) yards in any direction from the bottom of said shaft, the said mine operator, superintendent, agent, boss and miners shall be permitted to allow shooting or blasting twice in working hours only.

Sec. 2. That where powder, or other explosives, is used in mining or loosing coal, in any mine of this State, it shall be unlawful for any miner or other persons to fire any shot in any working place, on any entry, before all shots in places beyond such working place have been fired, and all miners and other persons have passed such working place on their way to the outlet of such mine.

Sec. 3. That in any mine in this State where coal is mined by "blasting off the solid" it shall be unlawful for any miner or other person to drill any hole, for the purpose of blasting, more than one foot past the end of the cutting or "loose end," or to prepare a "shot" in such a way that the distance from the hole to the loose end shall be more than five feet, measured at right angles to the direction of the hole.

Sec. 4. That it shall be unlawful for any miner, or other person, to place in any hole, for the purpose of blasting coal or other material, in any coal mine in this State, more than eight pounds of blasting powder, or to light a squib, fuse or other device with a purpose to discharge any shot which he knows to contain more than eight pounds of blasting powder, or to discharge any such shot by the use of an electric battery or any other device which may be used for such purpose.

Sec. 5. It shall be the duty of the mine operator or superintendent or agent or mine boss to see that section one (1) of this act be enforced or carried out.

Sec. 6. And for violation of any section of this act the same parties, the mine operator, superintendent, agent, boss and miners, shall be guilty of a misdemeanor, and for such offense shall be fined not over (\$100) one hundred dollars, nor less than (\$5) five dollars, or

imprisoned in the county jail not over (6) six months, nor less than (30) thirty days for each offense.

Both of the above acts have been generally complied with, and it is believed have resulted in much good. Last year, three fatal accidents occurred by reason of heavy shot firing; this year, no fatal accident from this cause is reported. There is no doubt that the provision of the law relative to rotation in shot firing will result in avoiding many accidents. Formerly such accidents were frequent, but if the present law on that subject is observed no such accidents are likely to occur.

Much has been done by legislation for those connected with the mining industry; but the laws on this subject are still weak and defective in many respects, oftentimes rendering them unenforceable. It many times occurs that the Inspector is thought lax in diligence, when in fact the difficulty lies in the defectiveness of the law itself—sometimes by reason of an inadequacy of power, at other times for want of a proper and efficient remedy.

It requires time, careful thought and persistent and patient effort to bring a system of mining laws to anything like a state of perfection. In the meantime, the more ignorant and easily prejudiced of the craft are prone to attribute all the fault to those charged with the execution of the laws, to misjudge their actions and motive, and to question their ability and good faith.

NEEDED LEGISLATION.

On the subject of future legislation, the following acts and amendments of present laws (a number of which were also recommended by my predecessor) are recommended:

1. In all cases where the Inspector is authorized to order the men out of a mine, he should be permitted to bring an injunction suit in the name of the State and to prosecute it without filing a bond, and have the services of the law officers of the State, as he now has in criminal cases.

2. Whenever the Mine Inspector shall find men working without sufficient air or under any unsafe condition, he should be authorized to bring suit immediately without giving the notice now required. As the law now stands, it permits mine operators to allow their mines to get into a bad condition between the visits of the Inspector, knowing that a reasonable time must be given to make repairs before they are subjected to a fine. With the best work that can be done by the Mine Inspector and the law officers of the State, a mine may run in an unfit condition for ten months of the year.

3. When a new mine is opened, or one resumes work after a shut-down, notice should be given to the Inspector so that he may know of the fact. In several instances mines have been reopened after a long stoppage, and operated, usually under very bad conditions, for six weeks before the knowledge of the fact comes to this office by the reports now required by law.

4. The Inspector should be given some supervision over small mines. There are numerous mines in the State which, during some part of the year, employ a sufficient number of men to bring them within the operation of the law, and for the rest of the year employ but a few men. If the Inspector visits them at a time when less than ten men are employed, he has no power to order improvements made, and the visit is wasted. When the number of men is increased, the mine is run without complying with the law, and, as this is usually at the busy season of the year, visits of inspection can not be made without neglecting more important work. In addition to this, employes of small mines are denied the protection and benefits of the law at all times.

5. It frequently occurs that when a surveyor has been appointed to make a map of a mine, as provided by law, in case where the operator has failed or refused to do so, he is compelled to resort to the courts to secure the pay for his work; and that, in such litigation, it requires a large part of the money thus earned by him to pay his attorney fees and other expenses. We recommend the law be so amended that, in case such surveyor is compelled to employ an attorney to recover pay for the services rendered in such work, he be entitled to recover a reasonable attorney fee, in addition to his compensation and costs.

7. The provision in the above act relative to shooting has been construed by the Attorney-General as not prohibiting shooting during the noon hour in certain cases. His decision on this subject is as follows:

INDIANAPOLIS, IND., June 23, 1899.

Hon. James Epperson, State Mine Inspector, Linton, Indiana :

Dear Sir—Replying to yours of the 21st, in which you ask what is meant by the term "working hours," in section 1, of the act approved March 4, 1899 (Acts of 1899, p. 382):

There is nothing in the law to aid me in interpreting this phrase. Taking it as it stands, it is my opinion that it would naturally mean hours established by rules of work in the mines. If it is the known and established rule for the miners to quit work at 12 o'clock in a certain mine and not to resume their work until 1 o'clock, then the interim from 12 to 1

would not be a working hour for that mine, but the application of this interpretation should be made in accordance with the fixed rules of each individual case.

Very truly yours,

W. L. TAYLOR,
Attorney-General.

The above act ought to be amended so as to prohibit shot firing from starting time in the morning until quitting time in the evening.

8. In many places in nearly all the mines there are long stretches of entry so narrow that a person can not stand at the side of the track and let a trip of cars pass him. These narrow places frequently occur on grades, where the cars run at a high rate of speed. Quite a number of accidents have occurred by men meeting trips of cars in such narrow places and being unable to get out of the way. Many accidents have been narrowly averted by such meetings. Niches in the coal, or manways at the side of the track, could be provided in such narrow places, at a comparatively small cost, giving immunity from danger to all persons passing along such entries; and I recommend that such legislation be enacted by the next legislature.

9. The present law relative to hoisting engineers and mine and fire bosses provided for a service certificate for all who had served three years, as well as certificate of competency procured by examination. We presume this provision of the law is based upon the theory that such service was conclusive evidence of competency. Experience leads me to believe that this provision of the law ought to be changed, and that all persons engaged in these positions ought to be required to pass periodical examinations. The benefit of this change will readily suggest itself to all thoughtful persons who give the matter serious consideration.

The State of Illinois has had such a law for some years, resulting in much good to all concerned.

We would further recommend that the examinations for certificates of competency be placed in the hands of a board of examiners, composed of one operator, one miner, one mechanical engineer and the Inspector of Mines and Deputy Inspector of Mines. This might add to the efficiency and thoroughness of this work, and would probably prove more satisfactory to those who are required to submit to these examinations. At least it would free such examinations from any suspicion of favoritism.

MINOR ACCIDENTS REPORTED AT INDIANA MINES, 1899.

NAME.	DATE.	OCCUPATION.	INJURY.	CAUSE.	MINE.	COUNTY.
John Powers	Jan. 20		Foot mashed.	Falling coal	Eureka No. 2	Clay.
J. P. Riggs	Jan. 28		Knee injured	Falling coal	Pratt	Clay.
Andrew Linsey	Jan.		Finger mashed	Falling coal	Gart No. 3	Clay.
William Pence	Jan.		Foot mashed	Falling coal	Crawford No. 4	Clay.
William Kockey	Jan.		Head cut.		Rob Roy	Clay.
C. Bodypenny	Jan.		Body bruised	Caught by cage	Briar Hill	Clay.
Van Suggs	Jan. 7	Miner	Burned	Heavy shot firing	Torrey No. 4	Vermillion.
William Phipps	Jan. 7	Miner	Burned	Heavy shot firing	Torrey No. 4	Vermillion.
George Vanderver	Feb.	Driver	Toes broken	Loaded car	Brazil B. C. Co. No. 1.	Clay.
Samuel Cammock	Feb.	Miner	Finger washed	Falling coal	Gart No. 5	Clay.
Samuel Smith	Feb. 24	Laborer	Foot mashed	Caught by coal chute	Crawford No. 5	Clay.
Wesley Brooks	Feb.	Miner	Leg sprained	Caught by coal chute	South Linton	Greene.
E. Holden	Feb. 4	Driver	Face bruised	Kicked by mule	Brazil B. C. Co. No. 1.	Clay.
Lay L. Sharp	Feb.		Foot mashed	Falling coal	Eureka No. 2	Clay.
Frank Cramer	Feb.	Miner	Knee hurt	Falling coal	Shelburn	Sullivan.
Wayne Bennie	Feb.	Miner	Hand mashed	Falling coal	Broadhurst	Vigo.
John Mahaut	Feb.	Miner	Hand mashed	Falling slate	Star	Warrick.
Edward McCann	March 22	Miner	Arm bruised	Falling coal	Brazil B. C. Co. No. 11	Clay.
Alex. Gilmore	March 22	Miner	Leg bruised	Falling coal	Eureka No. 2	Clay.
C. F. Dowell	March	Miner	Finger mashed	Struck by coal	Eureka No. 2	Clay.
Alex. Gray	March	Car trimmer	Back bruised	Falling slate	Harrison No. 2	Clay.
Wm. Props	March 18	Miner	Shoulder hurt	Between cars	Summit	Greene.
Thomas Ellis	March 14	Driver	Leg injured	Coal falling off car	Templeton	Greene.
Thomas Kinney	March	Driver	Body bruised	By mine car	Otte-Creek No. 1	Parks.
Henry White	March 17	Driver	Body bruised	By mine car	Brazil B. C. Co. No. 12	Parks.
John McCann	March 25	Miner	Body bruised	Falling coal	Brazil B. C. Co. No. 12	Parks.
Samuel Welch	March	Miner	Body bruised	Falling slate	Phoenix	Sullivan.
Joe Clark	March 8	Miner	Sprained ankle.	Falling slate.	Brazil	Clay.
Joe Gasvo	March 20	Miner	Body bruised	Caught between cars	Cox No. 3	Parks.
Jarvis Wills	March	Miner	Back hurt	Falling slate.	Gart No. 5	Clay.
William Spence	April	Miner	Wrist dislocated	Mine car	Crawford No. 5	Clay.
Bonnie James	April 4	Miner	Hip injured	Falling slate	Summit	Greene.
Arthur Elston	April	Miner	Hip injured	Falling slate	Otter Creek	Parks.
Chester McKinney	April	Miner	Body bruised	Falling slate	Star City	Sullivan.
F. McCrocklin	April	Miner	Body bruised	Mine car	Diamond	Vigo.
Roscoe Haase	April	Car trimmer	Three fingers cut off	Coupling cars	Peerless	Vigo.
John Hill	May 9	Miner	Ankle bruised	Falling slate	Peerless	Vigo.
Yorhees Harpold	May 9	Miner	Back hurt	Falling slate	Peerless	Vigo.
Frank Ruhalla	May 1	Miner	Ankle dislocated	Falling slate	Brazil B. C. Co. No. 8	Clay.
William Swaddy	May 23	Driver	Leg hurt	Falling slate	Klondyke	Vigo.
William Robison	May 23	Miner	Foot hurt	Mine car	Brazil B. C. Co. No. 8	Clay.
William Benson	May 25	Miner	Foot hurt	Falling slate	Silverwood	Greene.
Doek Cruden	May 25	Miner	Foot hurt	Falling slate	Summit	Greene.

William Goodman	May	Driver	Body bruised	Mine car	Dagger	Sullivan.
John Hill	May 22	Miner	Ankle hurt	Draw slate	Peerless	Vigo.
H. Evans	May 23	Miner	Burned	Gas explosion	Lyford No. 2	Parke.
H. Evans	May 23	Miner	Burned	Gas explosion	Lyford No. 2	Parke.
Mathew Phipps	May 4	Miner	Burned	Premature blast	Crawford No. 5	Clay.
William Alisman	May	Pumper	Crushed	Caught by cage	Bush Creek	Sullivan.
Frank Watsel	June 4	Miner	Hand hurt	Falling coal	Crawford No. 5	Clay.
Samuel Bugy	June 26	Sinker	Body bruised	Falling tub	Silverwood	Mountain.
George Anderson	June 12	Miner	Body injured	Falling slate	Lyford No. 2	Parke.
Daniel Walton	June	Miner	Back injured	Falling slate	Lyford No. 2	Clay.
George Williams	June 3	Driver	Foot hurt	Mine car	Peerless	Vigo.
David Leach	June 15	Miner	Body bruised	Falling slate	Peerless	Vigo.
Jamee Smith	June 14	Driver	Ribs fractured	Kicked by mule	Briar Hill	Clay.
Daniel Lambaugh	July	Driver	Foot mashed	Moving machine	Dagger	Sullivan.
W. P. Wood	July	Miner	Leg bruised		Phoenix No. 1	Sullivan.
Sylvester Gorey	July	Miner	Leg mashed		Phoenix No. 1	Sullivan.
Had Watson	July	Driver	Rib fractured		Troy	Perry.
Wm. Schanok	July 7	Miner	Back hurt	Falling slate	Crawford No. 1	Clay.
Wm. Roberts	July 20	Miner	Foot sprained	Falling slate	Mecca No. 1	Parke.
Wm. Johnson	July 20	Miner	Body bruised	Draw slate	Mecca No. 1	Parke.
Ed. Don	July 14	Driver	Bruised slightly	Falling slate	Templeton	Greene.
John Pieker	July 7	Driver	Bruised slightly	Mine car	Klondyke	Clay.
West Poland	July 17	Driver	Foot mashed		Brasil B. C. Co. No. 12	Parke.
James Danniichey	July 28	Miner	Arm and ankle hurt	Falling slate	Crawford No. 5	Clay.
Ed. Tolson	July 21	Miner	Leg hurt	Went back on shot	Pratt	Clay.
Mat Reynolds	July 25	Driver	Foot hurt	Mine car	Gladstone	Clay.
Robert Maunkhouse	Aug. 3	Miner	Neck and sh'lder bruised	Falling slate	Phoenix No. 1	Sullivan.
A. A. Tucker	Sept.	Miner	Foot mashed		Phoenix No. 1	Sullivan.
Charles Phipps	Sept.	Day man	Foot mashed		Mecca No. 1	Parke.
Wm. Edwards	Sept. 28	Timberman	Foot mashed		Summit No. 2	Greene.
Elmir Thomas	Sept.	Loader	Leg hurt		Summit No. 2	Greene.
Millard	Sept.	Driver	Nose and mouth mashed		Standard	Parke.
Wm. Havercamp	Sept.	Miner	Body bruised		Standard	Parke.
Clarence Roush	Sept.	Miner	Body bruised		Lyford No. 2	Parke.
Morgan Clements	Oct. 20	Driver	Hand mashed		Lyford No. 2	Parke.
Ross Williams	Oct. 27	Miner	Hand mashed		Wureka No. 2	Clay.
Columbu Bowers	Oct. 27	Driver	Back hurt		Klondyke	Clay.
Cad Rugh	Oct. 26	Miner	Back and leg bruised		Summit No. 1	Greene.
Mike Grabin	Oct. 7	Driver	Slightly bruised		Lyford No. 2	Parke.
Albert Jones	Oct. 19	Miner	Foot cut		Brasil B. C. Co. No. 12	Parke.
James Charles	Nov. 1	Driver	Body bruised		Sawleyville	Vigo.
T. J. House	Nov. 8	Miner	Fractured rib		Oswald	Gibson.
Fred Hartweck	Nov. 14	Miner	Body bruised		Green Hill	Sullivan.
John Hamrock	Nov.	Driver	Body bruised		Dagger	Sullivan.
Luther Daniels	Nov.	Driver	Body bruised		Oswald	Gibson.
William Gardner	Nov. 14	Driver	Body hurt		Crawford No. 5	Clay.
Thomas Darby	Nov. 9	Miner	Slightly bruised		Gladstone	Clay.
Joe Myrick	Dec. 6	Miner	Burned		Brasil B. C. Co. No. 12	Parke.
				Explosion of powder charging		
				Note		

MINOR ACCIDENTS REPORTED AT INDIANA MINES, 1899—Continued.

NAMES.	DATE.	OCCUPATION.	INJURY.	CAUSE.	MINE.	COUNTY.
John Gilpin	Dec. 18	Driver	Leg hurt	Caught between car and door.	Cox No. 3	Parke.
William Morris	Dec. 18		Body bruised	Draw slate	Eureka No. 2	Clay.
John Kirkland	Dec. 5	Loader	Leg and shoulder bruised	Draw slate	Brazil B. C. Co. No. 11	Clay.
Sylvester Newman	Dec. 12	Driver	Foot mashed	Mine car	Summit No. 1	Greene.
Alfred Burr	Dec.	Miner	Leg bruised	Falling slate	Rob Roy	Clay.
John Elliott	Dec. 16	Driver	Bruised	Between cars	Rob No. 3	Clay.
Anthony Lonx	Dec. 17	Driver	Foot hurt	Mine car	Alondyke	Vigo.
	Dec. 17	Miner	Body bruised	Shot	Star No. 1	Warrick.
	Dec. 17	Miner	Body bruised	Shot	Star No. 2	Warrick.

SERIOUS ACCIDENTS REPORTED AT INDIANA MINES, 1899.

NAMES.	DATE.	OCCUPATION.	INJURY.	CAUSE.	MINE.	COUNTY.
C. Bridgewater	Jan. 28		Leg broken	Falling slate	Fairview Mine	Clay.
Robert Steele	Jan. 28		Back injured	Mine car	Gart No. 5	Clay.
Curt Marsh	Jan. 31	Trapper	Leg broken	Falling slate	Island City No. 1	Greene.
Edward Engfert	Jan. 31	Miner	Back and body hurt	Falling slate	McIntosh No. 1	Parke.
John Engfert	Jan. 31	Miner	Body badly bruised	Falling slate	McIntosh No. 1	Parke.
Charles Keed	Jan. 31	Driver	Foot crushed	Caught by car	Buckeye	Vermillion.
Memnon Stevenson	Feb. 10	Miner	Body burned	Powder explosion	Eureka No. 3	Clay.
John Thomas	Feb.	Driver	Arm broken	Caught by car	Eureka No. 2	Clay.
Larness White.	Feb.	Miner	Rib broken	Falling slate	Briar Hill	Clay.
George Shale	Feb. 8	Miner	Bruised	Falling of cage	Harrison No. 3	Clay.
John Howe	Feb. 7	Driver	Leg broken	Falling of mine car	Star City	Sullivan.
Frank Gray	Feb.	Driver	Collar bone broken	Caught between roof and car	Ingleside	Vanderburgh.
Henry Mucher	Feb.	Cager	Back hurt	Falling slate	Union	Vigo.
John Keller	Feb.		Leg broken	Caught by cage	Star No. 3	Warrick.
John Davidson	March 30		Leg broken	Caught betw'n hopper & screen	Shirkey No. 4	Parke.
Steve Thomas	May 15	Miner	Burned and bruised	Gas explosion	Lyford No. 2	Vermillion.
Charles Harmon	May 23	Miner	Burned and bruised	Gas explosion	Lyford No. 2	Parke.
John Bonar	May 23	Miner	Burned and bruised	Gas explosion	Lyford No. 2	Parke.
John Low	June 26	Miner	Leg broken	Falling coal	Parke No. 8	Parke.
Luke Bending	July 13	Miner	Back broken	Draw slate	Columbia No. 4	Clay.
M. Sobra	August 21	Miner	Collar bone broken	Falling slate	McIntosh & Co. No. 1	Parke.

SERIOUS ACCIDENTS REPORTED AT INDIANA MINES, 1899—Continued.

NAMES.	DATE.	OCCUPATION.	INJURY.	CAUSE.	MINE.	COUNTY.
Harris	Sept.	Miner	Body burned	Shot through pillar	Oswald	Gibson.
Louis Race	Oct. 17	Miner	Face & hands badly b'nd	Explosion charging shot	Columbia No. 2	Parke.
Felice Timberman	Oct. 26	Miner	Leg broken	Falling slate	Cox No. 3	Parke.
Walter Knox	Oct. 9	Mine boss	Ribs, 1 b'k'n, 2 fract'd	Falling slate	Crawford No. 5	Clay.
J. B. Small	Oct. 31	Miner	Shoulder broken	Falling coal	Island Valley	Greene.
Joseph Altenbaugh	Oct. 31	Miner	Leg broken	Draw slate	Summit No. 1	Greene.
Bana Cava	Oct.	Driver	Leg broken	Caught by cage	Superior No. 1	Parke.
Al. Smith	Oct. 3	Driver	Jaw broke twice	Falling slate	Duger	Sullivan.
P. Kelskner	Oct.	Driver	Leg broken	Mine car	Eureka	Vermillion.
John Shocktaw	Nov. 20	Miner	Eyes burned	Went back on squibbed shot	Summit No. 1	Greene.
Carl Shocktaw	Nov. 20	Miner	Spine injured	Went back on squibbed shot	Summit No. 1	Greene.
Roy Hawkins	Nov. 24	Miner	Spine injured	Draw slate	Ingleide	Sullivan.
Henry Thomas	Dec. 15	Miner	Face and hands burned	Windy shot	Eureka	Vermillion.
Wm. McDowald	Dec. 5	Driver	Broken leg	Mine car	Brasil B.C. Co. No. 11	Clay.

FATAL ACCIDENTS REPORTED AT INDIANA MINES, 1899.

NAMES.	DATE.	OCCUPATION.	INJURY.	CAUSE.	MINE.	COUNTY.
Frank Vanhook	Jan.	Miner	Found dead in room	Unknown	Union	Vigo.
Morris James	Feb. 1	Cage	Body crushed	Caught by cage	Prince	Vermillion.
D. B. Hall	Mar. 15	Mine boss	Found in sump	Unknown	Dorsey	Warrock.
James Sporn	May 2	Driver	Crushed	Mine car	Lyford No. 2	Parke.
Clifton Hankins	June 7	Driver	Crushed	Mine cars on grade	Lyford No. 2	Parke.
George Lawton	July 4	Driver	Head and chest crushed	Falling slate	Brasil B. C. Co. No. 1	Clay.
Thomas Davis	July 4	Driver	Head and chest crushed	Falling slate	Corry No. 4	Vermillion.
Jacob Niedinger	Aug. 22	Miner	Killed	Falling slate	Columbia No. 4	Clay.
Wiley Buck	Sept. 22	Miner	Killed instantly	Falling slate	Bicknell	Knox.
Herman Minnis	Sept. 23	Miner	Killed instantly	Falling slate	Seeleyville	Vigo.
George Thomas	Sept. 23	Miner	Fatally hurt	Shot blowing through pillar	Seeleyville	Vigo.
Joe Sleva	Oct. 14	Miner	Killed instantly	Falling slate	Superior No. 2	Parke.
John Williams	Nov. 23	Miner	Killed instantly	Falling slate	Superior	Vigo.
Jackson Nevins	Dec. 9	Non-employee	Killed instantly	Falling in shaft at night	Mecca No. 1	Parke.
William Adamson	Dec. 11	Miner	Killed instantly	Fell in shaft at night	Torrey No. 4	Vermillion.

NOTE.—Man killed at Hawkins Mine, Daviess County. No record of name or date.

ABANDONED MINES.

The following is a list of mines, by counties, abandoned during the year, together with the names of the companies operating the same and the date of abandonment:

CLAY COUNTY.

Otter Creek Coal Company, Fairview Mine, block coal, during the month of October.

Jackson Coal and Mining Company, Brazil Mine, block coal, during the month of June.

Brazil Block Coal Company, No. 7 Mine, block coal, during the month of April.

Samuel Pyrah, Pyrah No. 3 Mine, block coal, during the month of February.

D. H. Davis Coal Company, World's Fair Mine, block coal, during the month of December.

Crawford Coal Company, No. 2 Mine, block coal, during the month of March.

Crawford Coal Company, No. 3 Mine, block coal, during the month of February.

DAVISS COUNTY.

Daviess County Coal Company, Montgomery No. 1 Mine, bituminous coal, during the month of January.

FOUNTAIN COUNTY.

Indiana Bituminous Coal Company, Silverwood No. 2 Mine, bituminous coal, during the month of September.

OWEN COUNTY.

Lancaster Block Coal Company, No. 2 Mine, block coal, during the month of March.

PARKE COUNTY.

I. McIntosh & Co., No. 1 Mine, block coal, during the month of August.

SULLIVAN COUNTY.

The New Curryville Coal Company, Curryville Mine, bituminous coal.

The force in this mine was reduced last year to less than ten men, to evade the law. The company continued to operate it in a desultory manner until May or June of the present year, when the mine was dismantled and abandoned and the hoisting machinery sold to the Green Hill Coal Company.

DESCRIPTION OF MINES.

My predecessor, in his report for 1898 (see Report of State Geologist for 1898, pages 1609 to 1697, inclusive), gave a full description of all mines, subject to the mining laws of Indiana; and, therefore, we deem it inadvisable to repeat these descriptions in this report, but refer those who may desire such information to the above mentioned report. I give herewith, however, a description of all new mines not contained in the report referred to.

MARY MINE.

This mine is located one and one-half miles northeast of Diamond, in Parke County, on the Brazil Block Coal Company's No. 12 Mine switch, which leads from a branch of the C. & I. C. R. R. The shaft is 8 by 18 feet in size and 105 feet deep. The coal seam is four feet and ten inches thick and is an excellent quality of block coal. In sinking the shaft two strata of quicksand were struck, which gave considerable trouble, the first of which was 18 feet thick and the second 35 feet thick, between which was 22 feet of hard-pan. At the point where the shaft struck the coal, its roof is a sand slate or shale, making a bad top; and, at present, only 12 men are employed in the mine, working three shifts of four men to a shift, doing little but driving entries prospecting in search of better roof.

ZELLER, McCLELLAN AND COMPANY'S No. 1 MINE.

This mine is located about one mile east of Diamond, in Parke County, on a branch of the C. & I. C. R. R. The top vein was abandoned about May 1, and sinking to the bottom vein, which lies 40 feet below the upper one, was commenced and the sinking completed in 10 days. At this time, 150 men are employed in the mine, and it has a capacity of 500 tons per day. The shaft is 8 by 21 feet in size

and is located in the southeast corner of a block of 200 acres of coal, owned by this company, averaging three feet and seven inches in thickness, which rises to the east and north, thus affording good and inexpensive drainage and also facilitating the haulage of coal. The roof is a sand slate of good quality, requiring much less timber than is usually required in the block coal veins.

SILVERWOOD MINE.

This mine is located near Silverwood in Fountain County, on the T., St. L. & K. C. R. R., and is owned and operated by the Indiana Bituminous Coal Company. The shaft is located in a basin of coal of fine quality about three miles long and one mile wide, averaging six feet and six inches in height. The shaft is 8 by 18 feet in the clear and 86 feet deep, and was commenced on June 19, and reached the coal a short time later. It is equipped with self-dumping cages of Prox & Brinkman make.

WHITE ASH MINE.

This mine is located one-half mile east of Hymera, on the Farmersburg branch of the E. & T. H. R. R., and is operated by the White Ash Coal Company. The shaft is 7 by 20 feet in size and 53 feet deep. The vein is "Coal V" and is very irregular in this mine. On the west side of the shaft the vein has an average thickness of six feet and four inches, while on the east side it gradually thins, until, at the head of the main east entry, the coal is but little over four feet in thickness. The roof is usually of very excellent character. Immediately above the coal is a stratum of hard black slate, ranging from three to five feet in thickness, which in turn is overlaid with about three feet of limestone. This mine was opened in 1893 by Marshall Zenor, who continued to operate it until 1894, when, for some reason, he closed it down and it stood idle until December, 1898, when the present company leased it. They, however, only operated it on a small scale until about March of the present year. My first inspection was made on June 26, and several defects were observed. The company was given ten days in which to remedy the defects noted and to report the same to me, which they did in the time given them. On October 26, I again visited this mine, and found considerable improvement had been made in the way of equipment since my last inspection, and also found the mine in good condition. At this time they were working 27 miners and four day men, with an output of 150 tons per day.

SUMMIT No. 2.

This mine is located one and one-half miles northwest of Linton, is owned and operated by the Summit Coal Company, and has access to both the Illinois Central and Pennsylvania systems of railroads. The shaft is 8 by 15 feet in size and 150 feet deep. The vein will average about five and one-half feet in thickness and is known as "Coal VI" in Professor Ashley's report for 1898, being the same vein as is worked at nearly all the mines in Greene County. The shaft is very favorably located, being sunk in the basin of a block of coal about one mile square in area and having excellent roof and bottom. Ground was broken in July, 1898, and the shaft was completed and ready to furnish coal in the market January 12, 1899. The mining is done solely by electric chain machines of link belt machine pattern. The mine is furnished throughout with the most modern and latest improved equipment, and, when fully developed, will have a mining capacity not exceeded by any mine in the State. At the time of my inspection, made October 23, I found the mine in good condition and about 25 men employed therein; but, since that time, the working force has been nearly doubled and the mine now has a capacity of about 400 tons per day. Among other improvements added to this mine during the present year is an escape shaft, or second outlet, 8 by 10 feet in size, one-half which is bratticed off for a manway, and the other half for a fan shaft. On the fan shaft is placed a 12-foot steel fan of the Crawford & McCrimmon make, which furnishes excellent ventilation in all parts of the mine.

INGLESIDE MINE.

This mine is located in Sullivan County, about one mile south of Dugger, on the I. & V. Branch R. R., and is owned and operated by George Ingle, of Evansville, Indiana. This shaft is 8 by 18 feet in size, 50 feet deep, and was commenced July 7, and completed ready for shipping coal on October 1, of the present year. The vein is "Coal VI," has an average of about four feet, eight inches, and is being mined by electric chain machines of the "link belt" make. The power is furnished by a Jenney dynamo 30 K. W., and the mine is also equipped with Prox & Brinkman self-dumping cages. When the shaft was first sunk considerable trouble was had with faults and bad roof, the slate overlying the coal at the point where the shaft was sunk being very thin and falling to the sand rock; but after the entries had been driven for some distance from the shaft to the east, the slate

was found to be much thicker, and, from the present indications, it looks as though the roof would get good in that direction.

HYMERA MINE.

This mine is located in Hymera, on the Farmersburg Branch of the E. & T. H. R. R., and is operated by the Harder-Hafer Coal Company. The shaft has been sunk during the summer to the lower vein, or "Coal V," the top vein having been worked out and abandoned about May 14 last. The coal at the point where the shaft struck the lower vein is seven feet, six inches thick, of excellent quality, and the roof is very good, being a hard black slate. The coal is mined by electricity, the same as formerly used in the upper vein. I made three inspections of this mine during the past year. On the first inspection, April 23, I found some minor defects, which were promptly remedied on my request. Upon the second inspection, June 26, because of the defective condition at that time, I served upon the company the following notice:

LINTON, INDIANA, June 27, 1899.

Mr. Thomas Sutton, Mine Boss, Hymera Mine, Hymera, Indiana :

Dear Sir—On inspection of your mine yesterday, I find that part of the hoisting shaft, extending from the top vein to the surface, in what I considered a very dangerous condition. You will, perhaps, remember I called your attention to this at my last inspection, made April 23, and that we examined the shaft carefully that day. While we found that there was considerable squeeze on the curbing, which had bulged out in many places, yet we did not deem it unusually dangerous, as all of your men were working in the top vein at that time, and even had there been a break they could have got out of the mine easily without risk of life.

I think the condition of the shaft is much worse to-day than it was at that time, and nearly all of your men are working in the lower vein now, with no means of escape except by the main shaft.

I presume you are aware there is a large space around the shaft from the top vein to the surface, in which the curbing had been burned out, and, when recurbed, was filled in with loose dirt, logs, etc. You are undoubtedly also aware that should the curbing give way in that part of the shaft, which has been filled with loose dirt, that men working in the lower vein would have but little chance to escape.

I do not think it wise or prudent that men should be allowed to work in the mine while the shaft is in its present condition, and mentioned that fact to your superintendent yesterday. He informs me that he has ordered the timber to recurb the shaft and could be ready to commence on it within one week. This should give you ample time to make preparation for the work. And I hereby give you notice that no miner, or other persons, shall be allowed to work in the mine, only such as will be required

to do the timbering and repairing of the shaft. This notice is to take effect July 6, and continue until the shaft has been properly timbered and made safe and same reported to me. This notice does not apply to your pumper, who can go in and out of the mine to the top vein by means of the pump shaft.

JAMES EPPERSON,

Inspector of Mines.

The above notice was complied with, and at my next inspection I found the mine in good condition. At this last inspection, this mine was working about 35 men, the work being done mostly in the entries.

GREEN HILL MINE.

This mine is located about one and one-half miles east of the town of Sullivan, on the I. C. R. R. The shaft is 7 by 14 feet in size and 70 feet deep. The mine was opened in the summer of 1896, but stood idle most of the time until January 1 of the present year, when a joint stock company, composed mostly of miners, was organized and leased the mine. This company purchased the machinery, cars and equipment formerly used at the Curryville Mine, and moved it to this mine. The coal averages about four and one-half feet in thickness, is "Coal VI," and is sold exclusively to local trade at present. It is the intention of the company to lay a switch from the railroad to their mine next summer. The advisability of mining the coal with electric machinery is being seriously considered by the company. This mine became subject to the mining laws of the State in April of this year, and the first inspection was made by me April 4, the mine then having 13 men employed therein. I found the mine in good condition at that time, except a few minor defects, which the company agreed to remedy at once. I made another inspection in the October following and found the mine in good condition and 16 men employed in it.

ZELLER, McCLELLAN & COMPANY'S BITUMINOUS MINE.

This mine is located near Cloverland, Clay County, on the T. H. & I. Division of the Vandalia Line. The shaft was commenced August 7 (the sinking was completed within thirty days), and is 8 by 20 feet in size and 100 feet deep. The vein averages about six feet and six inches in height, the roof is gray shale, overlaid with a sand slate, and is "Coal VI." This is a pick or hand mine, and employs 60 miners, has a capacity of 350 tons of mine run daily, and is equipped with the ordinary Prox & Brinkman self-dumping cages. The company is constructing a slope, to be used as a manway, or second outlet, at the present time.

THE INDIANA MINING INSTITUTE.

The organization of the Institute was noted in the report of the Inspector of Mines for last year, and its objects fully stated. We have only its report on its progress during the year. The meetings are held quarterly, and no omissions were made in 1899. All of the meetings were well attended, with the exception of the one at Sullivan. The papers submitted during the year were not as many as the year previous, but the discussions were probably more general and interesting. In addition to a discussion of papers read, several subjects connected with coal mining were considered, and many interesting features brought out. The membership now numbers 75, and each meeting shows an increase; yet there are many eligible men who should belong, but who do not seem to see the advantage of the interchange of thoughts and experience which this association renders. I have yet to meet a man who attended a meeting that did not feel he had made some addition to his knowledge from its deliberations. There are some men who object to it as a labor organization, having obtained this false idea of its objects and methods. It is strictly an educational institution, and its objects so stated in the constitution, the idea being not to object to labor organizations, or organizations of other kinds, but to have an association for scientific and practical advancement.

In addition to papers and discussions mentioned, the Institute made visits to the Brazil Block Coal Company's mine to inspect a new electric motor, to Crawford & McCrimmon's machine shop to see Mr. Spears's pump, and to Prox & Brinkman Manufacturing Company to examine some new mining machinery.

At the annual meeting, July 29, 1899, the old officers were re-elected, as follows:

- M. McMorrow, President.
- Wm. Spears, Vice-President.
- G. S. Patterson, Secretary.
- A. D. Scott, Treasurer.

The above officers, with the following, constitute the executive committee: P. J. Mooney, H. C. Payne, Robert Fisher.

This meeting was terminated in the evening by a banquet at the Terre Haute House.

Since the end of the year we have to record the death of Mr. Robert Fisher, ex-Mine Inspector, to whose efforts the organization of the Institute is due.

Mr. Fisher was very active in the affairs of the Institute while he was the Inspector of Mines, and continued his interest after retiring from office at the end of his term. To him is largely due the improvement in mining conditions in the State, and his mark will be left in the history of the industry in Indiana.

The headquarters are at the office of the Secretary, Room 400, Opera House Building, Terre Haute, Ind., where all members are welcome.

We add also a paper on "Mine Water and Pumps," by Wm. Spears, of Brazil.

MINE PUMPS AND PIPES AND ACID WATER.

BY WM. SPEARS.

(Sullivan Meeting, October 29, 1898.)

This is a very vexatious subject to think of and a difficult one to write about, as so little appears to be understood about the composition of the acid water.

However, in every mining district, where old coal mines are found, the coal companies, hoisting engineers and mine bosses think they know all about the effects of the water on pumps and pipes, and we are at a loss to know just what to do to overcome the difficulties that are in the way, and yet all coal operators will agree that the destruction of mine pumps and pipes by the action of mine water, containing sulphur, is among the most aggravating circumstances connected with the mining of coal. The constant wear and tear of pumps and pipes, caused by the action of acid water is placed among the heaviest expenses in the operation of a mine.

We think this is due to what is called sulphur or iron pyrites contained in the coal, and, of course, the more sulphur contained in the coal, the more acid will be found in the water.

Iron pyrites are composed of iron and sulphur in direct chemical combination. These substances have a strong affinity for each other; hence, anything containing sulphur is injurious to iron. These substances are more or less soluble in water, and the contamination of the water comes from the soaking and leaching of the "gob" piles. It is well known that the water in newly opened mines is not sulphury, where there are no old works close by, and is not injurious to pumps and pipes, and is generally good drinking water. This can only be explained by the supposition that the currents of water passing through the coal within their reach and the passages have become free from contamination, but the mining of coal disturbs these conditions, and fresh surfaces of sulphur coming in contact with the water in rooms, entries and gob piles, more or less of it becoming dissolved, renders the water corrosive.

And when we compare what we have seen and think, we know by observation that the older the mines become the worse will be the quality

of the water. No doubt some of this contamination of the water is known to come from the fire-clay under the coal, and also from some of the soft blue slate found around "faults."

It may be supposed that the clay and blue slate have become charged with the sulphur from the drainage through the coal in the ages gone by, or that comes from the rider veins.

Some believe that the clay contains some of the pyrites in itself, as we find it sometimes contains large quantities of iron.

Let me say here that a number of close observing mine experts believe that the contamination of the water comes from that source.

Whichever way it comes about, it comes, and has a very destructive influence upon everything made of iron, with which it comes in contact.

It is well known that dirt piles, which contain large quantities of fire-clay, coal and other refuse substances taken out of the mine, will affect the surface drainage for years, perhaps centuries, and any surface water coming from such source is utterly unfit for use in boilers. These circumstances, it seems to me, does prove the deleterious quality of the clay, coal and other refuse materials put in the dirt piles. These conditions seem to be universal in all coal mining districts.

Many ways are resorted to to discharge this corrosive water from the mines. In the olden times they bailed it out with buckets, near the "crop;" then pulled it with ropes and buckets; then the water box; then pumps of various kinds; but to-day we depend chiefly on steam pumps made of iron. This is all right when the water is not copperous, but when we find acid in the water, we are calling for something more durable.

These conditions have forced many of the coal companies and mine bosses to put on their thinking caps and consult with each other to see if something could be done to get a cheap pump, and your humble servant has thought of a plan; i. e., to make a pump much heavier than any now made of iron, and it would take longer to eat it up than the smaller ones, and to make the valve seats larger, and the perforations in the seats larger, so that the water would rush through more freely, and the discharge to be larger also. Then thought of something better, namely, to make a pump in sections, so that the parts that would wear out could be more easily replaced, as all pieces according to that number, and make the pump high enough so it could be cut off, and the top of the working barrel and the lower valve seats be made in a plate by themselves, just the same as the top valve plate has been made formerly, and have lugs cast on the pump by which to bolt it all together, of course using two gaskets instead of one, and then to cover all parts of the pump inside with a lining of bronze composition, so that the mine water would not touch the iron if possible; and then a brass plate five-eighths of an inch thick at the back of the stuffing box between the cradle and the water end of the pump, for, in bad water, the part that holds the packing always eats away. Also there are two small air chambers, one over each valve, and a crane to raise the top off and swing it to one side. There is also a lubricator on the piston-rod stuffing box.

I should have said that I do not claim the manufacturers charged too much for their pumps, as I understand the bronze costs from 16 to 20 cents per pound, so you see a big pump runs into money rapidly.

Mr. Albert Hixon, of Carbon, Ind., and myself have tried babbitt metal and lead to repair the parts which have become eaten away and to fill holes which have become eaten into the pump seats and bridges, and it was all O. K., and also find that some grades of this resist the acid water very well. I find, in talking with Mr. C. W. Crawford, of the Brazil Machine Shops, that to make a good bronze composition, lead and tin are the only metals available that are invulnerable, but of these tin is too expensive. Rabbitt metal is too brittle and is also too expensive.

Therefore, lead, mixed with other material, is the only metal to be had at a low price that will answer the purpose.

The fact that lead chambers are used in the distillation of sulphuric acid from iron pyrites is sufficient proof that it will stand the action of mine water.

Now let me say that Llewellyn Evans, an experienced man with mine pumps in Clay and Parke counties, thinks that the construction of this kind of a pump the best he ever saw.

Mr. James W. McClelland, Superintendent of the Brazil Block Coal Co., and Mr. William Zeller, General Manager of the Zeller & McClelland Co., both say it is just the pump we need for acid water.

Mr. W. W. Risher, Superintendent of the Crawford Coal Co., had a No. 10 pump made of this construction, and it is now on experimental trial in their No. 4 Mine, at Hoosiersville, Clay County, Indiana, pumping water from old works that have been standing for eighteen years, and has been running continuously for seventy days at sixty strokes per minute.

With your permission I will have present a photograph of this pump. The price of this pump will be about half the cost of a bronze composition pump, and should it wear out in time, the lining may be removed, and by adding more of the composition, it can be run over again. But I have digressed from my experience with the new idea pump.

Now a word or two on the subject of pipes. The water must be brought out of the interior of the mine. We must sink pump shafts, supply the steam to a pump in the woods or field, as they may happen, or put in pipes and have them eaten into holes by the acid water in from three to six months, or may be a longer time. We could use wooden pipes in some places, and I will here say that this acid water appears to preserve the wooden pipes.

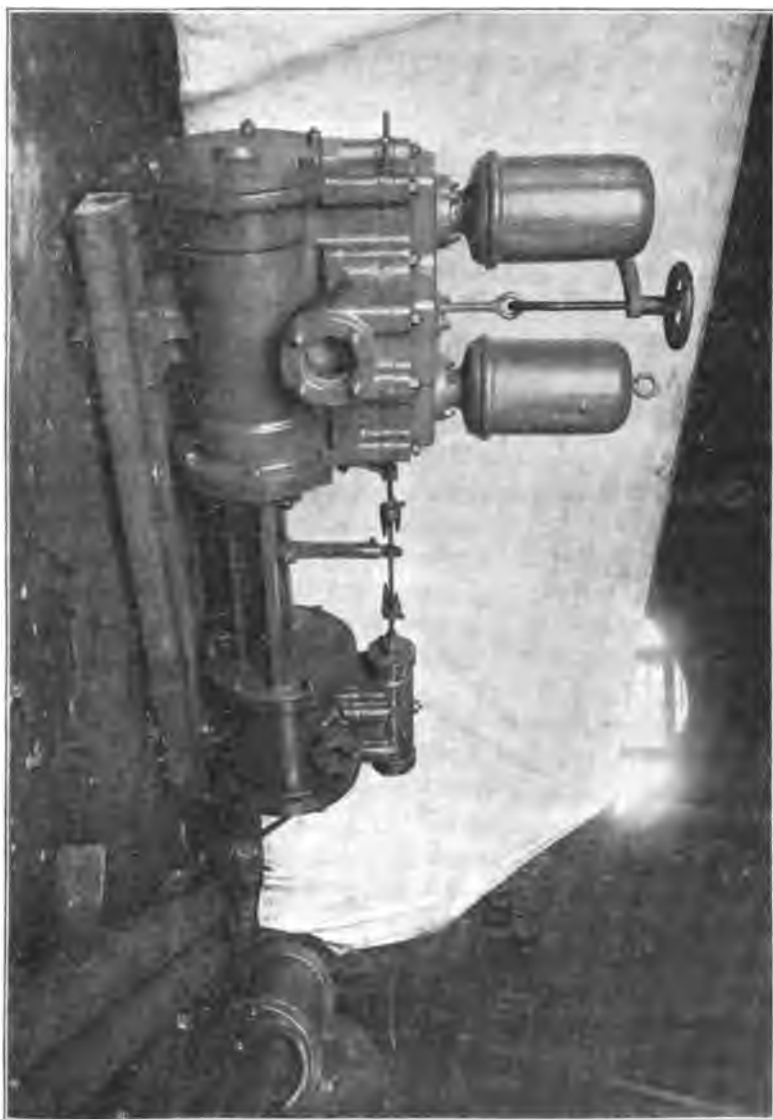
But the objection to wooden pipe is that it takes up so much room. You can not lay it along the side of the entry, and you can not hang it to the roof (it is so bunglesome), and when the roof is bad the entries have to be driven as narrow as possible in order to get the cross-bars as short as possible. Just imagine a mine with four or five piles of pipe in it, all eaten up. I have tried to turn some of them half over when the bottom began to go in holes, and the top side appeared to be good, and where the entry is straight, this was all right. But where the water runs along the outside of the pipe as well as the inside it is like the candle burning at both ends—it does not last long. When pipe is laying in the mud, with the water running over it at the side of the hauling road, I have tried to decide in my own mind whether the action of the water on the inside or the mud and water on the outside would eat the faster.

I believe the best way is to place the pipe as high and dry as possible. Put in a goodly number of unions, so the pipe can be taken apart without cutting it.

We often find a pipe so thin that we can not cut a new thread on it, and a part so poor we can not put a clamp on it; then we make what we call a cork joint. We slip a short three-inch pipe over a two-inch pipe and cork both ends tight with hemp packing or cloth covered with grease, and tightly wrap it with lamp wick or twine. I have seen the outside of the pipe painted, but am unable to say what was the result.

The only thing I can say is, to get a pipe made of soft material, such as will bend and not eat very rapidly. I have an idea in my mind of the material from which such pipe should be made, and will only add that steel pipe appears to crystallize and become brittle, and is not as good as iron pipe in bad acid water. And I think the day is not far distant when we will have a pipe that will answer the purpose.

The following is a photograph of the pump described by Mr. Spears in the above article:



REPORT OF THE STATE NATURAL GAS SUPERVISOR.

OFFICE OF NATURAL GAS SUPERVISOR,
KOKOMO, IND., January 15, 1900.

Prof. W. S. Blatchley, State Geologist:

SIR—I submit to you herewith the eighth annual report of this department. It is made in obedience to section 7504 of the Revised Statutes of the State of Indiana, and is for the year ending December 31, 1899. In this, my fifth annual report, I have tried to avoid all matter that would suggest a rehash of former reports, and have given most space to a statement of the present condition of the gas field, a subject of great interest at present to every consumer of natural gas. Other subjects are noticed only to the extent of their relation to this subject.

Acknowledging the cordial support that I have received at your hands during the past year, I remain,

Yours respectfully,

J. C. LEACH,
State Natural Gas Supervisor.

THE INDIANA NATURAL GAS FIELD.

The Indiana natural gas field is in the eastern central part of the State. In shape it is an irregular obovate, about 100 miles from north to south and 70 miles from east to west. The gas rock,¹ or "sand," as it is sometimes called, is Trenton limestone. This is a universal formation in this State, though not a universal gas rock. Developments in the Trenton limestone in numerous places throughout its area indicate that it has been the source of gas as well as other bitumens in many localities where they are not found now, and that it is only under certain conditions, necessary to gas accumulation, that this gaseous fuel remains imprisoned in the rock in which it was generated. Where these conditions do not exist, the gas has either escaped to the surface or to an overlying formation in which it is now held.

The conditions necessary for gas storage, referred to above, rest largely in the texture and structure of the rock, though not wholly. To be suited to gas storage, or to be a gas rock, a formation must be porous; must have small interstices or pores in which the gas can accumulate. In addition to the above, a gas rock possesses a structural relief sufficiently elevated to permit the gas, with the other substances present, to arrange themselves in the order of their specific gravity, that is, the water, the oil, if any, and the gas on top. The elevation is relative and not necessarily absolute, and acts as a trap in which the gas accumulates. Another necessary condition to gas accumulation is a cover for the gas rock. This must be a formation impervious to gas, else the gas would escape, probably to the surface.

I refer briefly to conditions in this field in the inverse order. The Utica shale, a formation impervious to water and gas, overlies the gas rock in this State and forms a perfect cover.

The Cincinnati arch meets the second condition. It is a low, broad elevation that crosses the eastern boundary of the State between Lawrenceburg and Liberty and extends in a northwestern direction across the State. Its surface is very uneven in places, having numer-

¹ By gas rock is meant a rock in which natural gas is stored, and not necessarily one in which it has been generated.

ous small ridges or folds, with occasional spurs extending at various angles from the main elevation.

As has been stated, the Trenton limestone is the reservoir for the gas in this field. Throughout the gas area this formation is more or less porous to a limited depth, which condition is due to its chemical composition. The carbonate of lime in the upper beds of the Trenton rock has given away, in part, to carbonate of magnesia. The result is a highly crystalline limestone of sufficient porosity to contain a large quantity of gas. The gas rock is not equally porous throughout the field nor of a uniform thickness, and, inasmuch as the productiveness of a gas rock depends upon its thickness and porosity, this field is not uniformly productive. As would be expected, the nearer the edge of the field, the less porous the rock becomes, until finally the porous rock becomes non-porous and the productive gas rock becomes a hard, barren limestone. In some places the transformation is slow, while in others it is sudden; very productive wells and absolute failures being drilled upon the same section of land. Specific reference is made to this subject as it affects this field in another part of this report.

It will thus be seen that it is not practical to determine the exact location of the boundary line of the gas field or its exact area; but wells have been located near enough to this line to draw the resources of the zone of uncertain territory. The area of the gas territory has been variously estimated from 3,500 to 4,000 square miles. When the former figure is given, it refers to productive gas territory. A fairly straight line, including the original gas territory, would include, approximately, 3,700 square miles.

CONDITION OF THE GAS FIELD.

During the early history of the gas field but little attention was given to this subject. After the gas area was located but few failures were recorded. Apparently nature had bestowed this gift with such lavish hands that the present generation need give no further attention to the fuel question. True, a few geologists said that the stock of this new fuel was fixed; that it could not last forever. But few believed this statement, and the wasteful manner in which it was used and the vandal-like waste permitted in some localities indicated an almost universal belief in an inexhaustible supply. As time went on, conditions began to change. Salt water invaded the field, and the productive wells in some localities, near the edge of the gas area, succumbed to its influence. Still, statements from the Natural Gas Supervisor that the history of other gas fields and the condition of

this indicated its ultimate exhaustion were branded as false, and made in the interest of gas companies, who desired to advance rates. State laws enacted to prohibit waste were difficult to enforce, owing to the adverse public sentiment. As the development of the field progressed, signs of failure in localities where the draught was heaviest became more apparent. The salt water became more intrusive, and the decrease in the rock pressure more marked. Thus, the history of the Indiana natural gas field has progressed since the first well was drilled, March 14, 1886.

Thirteen years have wrought a change in the public mind. It has been a struggle, but there are few, indeed, at present, who refuse to face the true condition of the field. Information regarding the progress of development, the advance of the salt water, capacity of wells, rock pressure, etc., is eagerly sought by manufacturers, gas companies and private consumers alike. I propose in this report to give such information as is most sought by consumers of natural gas; to make a true statement of the present condition of the gas field. This I have tried to do in previous reports, and it is most gratifying to me to know that the reports of the various committees sent by pipe line cities during the past year to investigate the condition of the natural gas supply have invariably verified the statements in my annual reports. There is no excuse for any one guessing or making exaggerated statements regarding the condition of the gas field. The true source of information is near at hand, and the facts can be easily ascertained.

GENERAL VIEW AND DIVISION OF THE FIELD.

As I have said, the productiveness of a gas rock depends upon its porosity. The Trenton limestone in this field does not possess a uniform porosity, and hence is not uniformly productive. Nor is this condition confined to any one locality. While as a general rule the gas rock is most productive away from the influence of the border of the gas area, that zone where the gas-holding rock changes to a hard, non-porous limestone, yet it is not an unusual thing to find wells of both large and small capacity on the same section of land in the interior of the field. In a few instances, wells showing neither gas nor water have been drilled near very productive wells.

CENTER OF THE FIELD.

The center of the gas territory, measuring from extreme to extreme of the cardinal points, is found to be about five miles southeast of Anderson, on a north and south line passing through Summitville.

This is not, however, the center of production or "heart" of the field. If by that point is meant that territory toward which the principal pipe lines are being extended and have not entered, and which has not been drilled except to supply local domestic consumption, it is near the northwest corner of Delaware County, and 24 miles north and three east of the geographical center of the gas area. The difference in the texture and structure of the gas rock and the unequal draught upon the northern and southern sections of the field are the principal causes of this divergence of centers.

The condition of the field can be better understood if the entire gas area be divided into two sections, with an east and west line parallel with the south boundary of Hamilton County and touching the same.

SOUTH SECTION.

This part of the field is triangular in shape; embraces parts of Marion, Hancock, Henry, Wayne, Rush, Shelby and Decatur counties, and contains approximately 850 square miles. In much of this section the gas rock is thin and hard, lacking the degree of porosity found in the northern section. The gas passes slowly from the rock to the wells, and, as a consequence, they are small and seldom overworked. Exceptions to this general statement are found in a few areas in the northern part of the section where the rock is quite porous and the wells large. In most instances, however, where these conditions exist, overwork has invited the salt water, and the wells have been comparatively shortlived. Pipe lines from this part of the field supply Connersville, Shelbyville and Hope. Aside from these cities, the draught is largely for local domestic consumption. The rock pressure varies from 75 to 275 pounds. The present indications and past history of this section of the field tend to confirm the idea that its gas supply, though comparatively small, will outlive that in the more productive part of the field.

NORTH SECTION.

When reference is made to the Indiana natural gas field, this section is usually in mind; not that it contains all the productive territory in the field, but it is from this section that a large majority of the pipe line cities are supplied, and in it the gas belt factories are centered. It embraces the whole of Madison, Delaware, Blackford and Grant counties, nearly all of Hamilton and Tipton counties, and parts of Howard, Miami, Wabash, Huntington, Wells, Jay, Randolph, Wayne,

Henry and Hancock counties. It contains (by difference) 2,850 square miles. Generally speaking, the gas rock in this section is more uniform in porosity and thickness than that in the southern part of the field.

DEVELOPMENT AND DRAUGHT.

The history of the discovery of natural gas in Indiana and the manner of development of this field is well known, and will receive a very brief notice here. The first wells were drilled in the vicinity of cities and towns by companies organized to supply gas for domestic purposes. It was not long until "farmer companies" were supplying the rural districts, and natural gas was a universal domestic fuel throughout the field. Nor was its use to cease here. Its value as a manufacturing fuel was soon known.

Factories of all classes, especially the large fuel consumers, were anxious to try the new fuel. At that time there were comparatively few factories in this part of the State. To-day the gas belt is the manufacturing center of the State, and if its fuel resources could have been kept within its borders, this industry would have been more extensive and the future of the field more promising. But this could not be so. The fuel value of natural gas was too well known and its transportation was a comparatively easy task. The initial rock pressure was 325 pounds. From 1888 to 1892 pipe lines were constructed to Indianapolis, Lebanon, Crawfordsville, Frankfort, Peru, Wabash, Huntington, Bluffton, Ft. Wayne, Decatur, Union City, Richmond, Connersville, Shelbyville and Chicago. A little later two lines were built from the eastern part of the field to Ohio, there, in addition to supplying a number of cities and towns, to supplement the rapidly diminishing supply of others that had formerly received an adequate supply from the field in the western part of that State. The Chicago and Ohio lines were equipped from the beginning with compressors to re-enforce the field pressure. Prior to the construction of these pipe lines there had been no systematic drilling in the field or effort to pre-empt territory. Cities were supplied from wells within their limits or the immediate vicinity, and but few factories went beyond their own yards for fuel. The pipe lines, radiating in every direction from this section of the field, tapped it at the nearest point. Thus, an outer zone around this entire section of the field was the first to be systematically and thoroughly developed, and, hence, the first to show signs of exhaustion. As wells near the edge of the gas area have become exhausted or the rock pressure reduced below that of the pipe lines,

this zone of territory supplying these lines has been moving toward the center of production. Pipe line companies have been compelled to plan their field of operation and hold large tracts of land under lease to protect their interests. This made it necessary for local gas companies and manufacturers to add an additional field expense. The leasing of territory has continued until practically the entire productive area is either under lease or its resources are controlled by adjoining land that is leased.

On account of the heavy pipe line draught on the border of the gas territory, and the necessary extension of the various lines from year to year, this section of the field presents three well defined divisions. First, the outer zone referred to above, which is exhausted for pipe line purposes. The wells are either exhausted or the rock pressure is below that of the pipe lines. This division varies greatly in width, it depending upon the pressure maintained in the various pipe lines as to when the wells become valueless as pipe line feeders. If all the territory was alike productive, then the draught upon a given line and the distance the gas is piped from the field would, to a large degree, determine the width of the zone in that locality; but as this is not true, even an approximately correct idea can not be gotten, except by an examination of the territory. This division is from 10 to 20 miles wide and contains about 1,400 square miles.

Second, a middle zone, which is the territory supplying pipe lines and a large majority of the factories in the gas field. It also varies in width and productiveness, and, in most localities, has been systematically and thoroughly developed. A few small areas at the head of minor pipe lines, supplying cities and factories, are not drilled. Some wells have been abandoned, and many on the outer edge of the zone do but little service during periods of light draught. The area of this division is approximately 1,350 square miles.

Third, the center of production, or that part of the field not invaded by pipe lines. It has for a center a point a little northeast of the northwest corner of Delaware County. Fairmount and Matthews are located within this area, and it contains about 100 square miles.

DEVELOPMENT, 1899.

The past year has been a very active one in the natural gas field. More line has been laid in the field and wells drilled by both manufacturers and gas companies than during any year previous. With the decline of the supply of gas and rock pressure has come the enforced tendency to enlarge main supply lines, parallel field lines and more

completely occupy the territory. While an occasional "gusher" has been drilled this year, the records of over 300 wells, old and new, located at various points throughout the field, show a decline in the volume of flow. Most of the wells drilled in 1899 show salt water, though its influence is being combated more successfully than ever before. This is done by drilling more wells, thereby lessening the draught on each well, and by the use of drips, separators, etc. Previous to 1899 13 compressing or pumping stations were maintained to re-enforce the field pressure. During the past year five new stations have been built and the capacity of five has been increased. The first factory to use a compressing station is the Muncie Glass Company, located at Muncie.

ROCK PRESSURE.

When speaking of the condition of a natural gas field, reference is usually made to the rock or closed pressure of the wells, it being the impression of many people that, accordingly as this is high or low, so are the wells large or small. This is not true in every instance, and as the supply of gas becomes more nearly exhausted this becomes a more uncertain index of the capacity of the wells. A decrease in the rock pressure of a given area of the gas field indicates a general diminution in the supply of gas in that area, but two wells on the same farm may have the same rock pressure and be very unequal in production. The velocity of the flow of gas at the well mouth is the only true index of the capacity of a well.

The original rock pressure of the Indiana natural gas field was 325 pounds. The heavy consumption of gas by all classes of consumers, from the beginning, soon became apparent in the decline of the rock pressure in those localities of largest draught. This was in the zone occupied by pipe lines and in the vicinity of cities and towns, though it was not long before the decline could be noticed in all parts of the field. The general decline has been gradual, showing greatest, of course, during periods of heavy consumption. For a number of years the decline in localities where the draught was somewhat equalized was about the same, and the rock pressure remained fairly uniform, but as time went on it became less uniform, local influences becoming more influential. It should be remembered that as the rock is not uniform in thickness both the lower and upper surfaces are more or less undulating. As the salt water advances, it may reach the upper surface of the rock at the synclines and hermetically seal the gas in elevated portions of the same; and thus, as the field progresses, it is

possible for the entire gas territory to be divided and subdivided into numerous small gas areas, varying in rock pressure, the draught in one locality not affecting others. Also, as the supply of gas becomes less it becomes more sensitive to the draught, and the pressure is less inclined to equalize.

It is difficult to ascertain the average rock pressure of the outer zone of the field, and, at most, it would give but little information as to the condition of this section. Wells in some localities, with a rock pressure of 250 pounds, have been abandoned on account of the presence of salt water. In time, a small amount of gas accumulates above the salt water horizon in these wells, and they register the same rock pressure as when abandoned. Thus abandoned wells in the western one-half of this zone are reported as showing a rock pressure much above that of the most productive part of the field. Though the rock pressure is high, the volume of gas is trivial. It is plain, I think, that to give the average rock pressure of the territory abandoned for pipe line purposes, or to include it with the other sections of the field, would give misleading results. To understand the present condition of the natural gas industry, the condition of all the territory in the northern section of the gas field, except the zone mentioned above, should be studied; for it not only supplies local domestic consumption and factories, and the larger cities in abandoned territory, but pipe line cities as well. November, 1897, the average rock pressure of this territory was 191 pounds. November, 1898, it was 173 pounds, a decrease in one year of 18 pounds. At present, practically the same territory shows an average rock pressure of 155 pounds. Of course it is understood that the area of this territory becomes less each year, and that the above results are not from data taken from the same wells year after year, but are the results of numerous tests made in the territory. The rock pressure in the undeveloped part of the above territory varies from 170 to 210 pounds.

CONSUMPTION OF NATURAL GAS.

At this time, when much unsatisfactory service is being reported, especially from pipe line cities, there is naturally considerable discussion as to the cause, and in connection much is being said about economical appliances and methods of using natural gas for fuel purposes. Is the consumer in any way responsible for defective service, and, if so, how? From the beginning all classes of consumers, with the possible exception of those who own their own gas plants, and have watched the progress of the field, have been slow to believe that the

stock of natural gas was being reduced by every cubic foot consumed; that the annual decrease in the rock pressure was rendering it more and more difficult each year to get the gas to the consumer, and correspondingly slow to investigate the advisability of adopting economical appliances for the consumption of this gaseous fuel. And, with this, it should be stated that not a few gas companies have been slow to learn the absolute necessity of enlarging and improving their plants to meet the ever changing condition of the gas field, and the increased consumption of gas. These conditions combined have, in many instances, resulted in poor service where it should have been otherwise.

Most of the cities using gas from this field are prosperous. Their history is one of growth. In many instances the population is twice, and in some instances three times, what it was twelve years ago. Most gas plants were built hurriedly, and for the present only. But few, indeed, were wise enough to forecast the future and build for its needs. Plants built to supply a city of 5,000 population are now expected to serve a city of 10,000 people. With the decrease in the rock pressure of the field has come the necessity for larger supply lines, regardless of the increased demands. When the gas moves slowly, it must move in larger volume. Finally, comes the necessity for compressors to re-enforce the field pressure. It rests with the gas company to supply the gas in sufficient volume and at a uniform pressure, and it is the duty of the consumer to use the most economical heating appliances for consuming the gas, and keep them clean and in repair. By an economical heating appliance I mean one (grate, stove, furnace or boiler) so fitted with burners and mixers and with the draft so regulated that all the gas supplied will be consumed and all the heat therefrom supplied to the room instead of passing in part out through the chimney, as in most cases is true. The aim of the consumer should be to secure a complete combustion of the gas, thereby realizing its full heating power. Incomplete combustion is not only wasteful but is almost sure to result in unsatisfactory service, even if the supply of gas is ample with the unfavorable conditions. It is also sure to result in the formation of carbonous oxide gas, which is extremely poisonous. Though the heating appliances are perfect and the supply of gas ample in the company's lines, the service will not be good if the piping in the house is faulty; that is, if it is too small and not properly placed and not kept clean. It is not practical to make specifications that will meet the conditions in all houses alike. The number of services and the consumption govern. As a general rule, the line from the street to the average house should not be less than one and one-fourth inches in diameter, and no pipe less than one-half inch. When

the service is poor and there is reason to suspect that the piping is at fault, the matter can be easily determined by a simple test. Let an ordinary water gauge be attached to a service pipe at any point (light, mixer, etc.) in the house. If the pipes are large enough and clean, the pressure will remain the same whether the fires are burning or not. If too small, or partially filled with foreign matter, the pressure will materially decrease when the fires are lighted.

I believe that many consumers of natural gas would find material relief from poor service in scientific plumbing and economic devices for consuming the gas. Of course these appliances will not take the place of gas nor relieve gas companies from the responsibility of supplying it in adequate volume, but they will aid the consumer in securing all the heat in the gas supplied, which, when the supply is short, is certainly a sufficient incentive. In many instances the gas burned in a grate that radiates but little heat would, if consumed under proper conditions, make a home comfortable.

Natural gas is an ideal domestic fuel, clean, labor-saving, and, when properly used, maintains a uniform temperature. Residents of the gas belt have enjoyed the luxury of its power since 1887, and many of the surrounding cities since 1890. To be compelled to return to other fuels will cause much inconvenience and no little expense. As much as it may be regretted, such will surely be the result. Would it not be well to think about it in advance; to prepare for it? As is known, gas belt cities have enjoyed a marvelous growth during the past ten years. Hundreds of residences have been built and fitted especially for the use of this fuel. A change in fuels will, in many cases, necessitate an entire change in heating appliances, grates, stoves, etc., and, in some instances, chimneys will have to be rebuilt to insure safety. However, the change will not come unheralded. Some cities have seen visions of the future very plainly this year; but the indications are that after the pipe line cities have ceased to draw from the field and the supply has become too limited for the large consumers, that the domestic consumers within the gas belt will enjoy the use of this fuel for a number of years.

THE MANUFACTURING INDUSTRY.

I will not detract from the merits of natural gas as a domestic fuel when I say that it is the most valuable manufacturing fuel known, although the cost has been small, indeed, to many. Free gas was usually a part of the subsidy given to factories to secure their location in the gas field. This was entirely unnecessary, as was any subsidy

at all, and was responsible to some extent for the wasteful use of this fuel for many years. The growth of the manufacturing industry in this section of the State, since the discovery of natural gas, has exceeded the most sanguine expectations. In 1886, only such factories were here as are usually found in agricultural regions such as this was. Now, factories of nearly every class, especially the large fuel consumers, are located here. In this way a vast amount of capital has been invested in the gas belt. In 1886, the property in Madison County was valued for taxation at \$9,773,805; at present, it is \$27,394,845, an increase in 13 years of \$17,621,040. The assessed valuation of property in Delaware County has increased from \$9,590,185 to \$21,632,900 since 1886. In Grant County it has increased from \$8,921,445 to \$23,000,000; and in Blackford County it is \$7,330,860 at present, while in 1886 it was \$2,871,114. And this, with town lots listed at something like their real value, instead of a fictitious value, such as was placed upon them in most instances during the early history of the natural gas field. Of course this large increase of wealth in these counties, and other counties in the gas belt, not mentioned, should be credited to their fuel resources, and not a small amount of it directly to gas wells, pipe lines, pumping stations, etc.

As has been stated, most factories in the gas belt are large fuel consumers. The fuel resources of this section of the State are responsible for their being here. It is now a generally accepted fact that the supply of this fuel is decreasing and will finally become exhausted; and no person is better acquainted with the true condition of the field than are the manufacturers. While some factories occupy substantially built buildings, others occupy structures that could be abandoned without much loss. In view of these conditions, then, is it not natural that much anxiety should be felt by residents of the gas field regarding the future of the manufacturing industry? When the natural gas supply is exhausted, will the factories remain where they are, or will they seek other locations? Time only can give a definite answer. I believe that a majority of the largest and most substantially built factories will successfully adopt other fuels and remain. This is the view entertained by the leading manufacturers, and, considering everything, it is rational. With the failure of the first wells, and the general decline of the field, has come to most manufacturers a keener appreciation of the value of natural gas as a fuel; a disposition to provide for the future as far as possible and husband their fuel resources. And, while it is true that manufacturers who have outlived a less productive field are very apprehensive concerning the future, they are

disposed to find another fuel in case it is necessary rather than a new location. Manufacturers do not want to change locations. It would entail quite an expense, and, in a measure, disturb their business for a time. A majority will make an honest effort to successfully adopt other fuels. A few now are using coal during periods of heavy draught, and as the supply decreases more will be compelled to supplement their gas supply with other fuel. The change will come gradually. Then, taking into consideration the proximity of the gas belt to the markets of the country and the Indiana coal fields, and the splendid railroad facilities possessed by this section, both with reference to the coal fields and the markets, it seems that a majority of the gas belt manufacturing industries are permanently located.

THE WASTE OF NATURAL GAS.

It should not be necessary to refer to this subject at this late day. It would seem, with the knowledge that consumers in general have of the condition of the field, that the seeming indifference to the extravagant use and waste of this valuable fuel that has existed since its discovery would be entirely displaced with an economy and care commensurate with its value. This is not the condition. While the waste of gas is growing less, and it is being consumed more economically than formerly, yet some gas is permitted to waste, and this should not be. More interest is being manifested in this subject now than ever before. Manufacturers, gas companies and residents of the gas belt have rendered me very great assistance during the past year by promptly notifying me of any avenue of waste coming to their notice and needing my attention. I have thus been able to do work that would otherwise have been impossible; for one man can not inspect all the gas property in the State often enough to accomplish the end sought.

A majority of the consumers of natural gas use it in such a manner as to waste much of its heating power. It is seldom, indeed, that the gas is all burned and the heat supplied where it belongs. Incomplete combustion is the rule rather than the exception, and this always means waste. This does not apply to the domestic consumer only, but to the manufacturer as well.

And, incomplete combustion is not the only avenue of waste by domestic consumers. In a majority of residences and business houses in the gas belt, more gas is used than is necessary even under present conditions. The temperature of most houses is kept above the health limit, and not infrequently are the doors and windows opened when the gas should be turned down. The heating power of natural gas is

cumulative, and fires need constant attention if the temperature is to be kept at a health limit. The present system of selling gas, the "contract system," is doubtless responsible for much of the indifference manifested by the average consumer toward methods of consumption and amount of gas used, and but little improvement can be expected until it is forced by a shortage in the supply. It is claimed by many, especially those engaged in selling gas, that the use of meters would not only prolong the life of the gas field but would tend to improve the service by the introduction of economical appliances and methods which would follow the introduction of the "meter system." Brief reference has been made to this in a former chapter. There can be no question as to the right method of selling gas. If natural gas is property, and can be transferred as other property is, it will harm no one to pay for it as he pays for other property. Those who oppose the "meter system" contend that the adoption of it will benefit the gas company only; that it means a higher price for gas. While this may be true, it is not necessarily so. I can see no reason why the rates could not be adjusted as equitably and as satisfactorily under one system as another. A schedule of prices under which I am compelled to pay for the gas which I use, and no more, is certainly just. If I choose to adopt economical appliances and practice economy, a reduction in my gas bill will follow. If I use it extravagantly, I pay for what I use and no more. It does not now seem probable that meters will ever be universally used, though by common consent or necessity their use will become more general each year. In the localities where the supply is short at times, consumers of gas will adopt meters, that they may pay for the gas they use and no more.

WASTE OF GAS FROM PIPE LINES.

Natural gas escaping from the many pipe lines, both large and small, that thread the gas territory in every direction, attracts the attention of the public more than any other avenue of waste. A very small leak will often make a noise that will magnify its importance. In the past a heavy drain upon the supply has come from this source. Conditions are much better than formerly, but not what they should be yet. It is possible to keep the large pipe lines that are buried a reasonable depth underground comparatively tight, but the small lines lying on top the ground present a more difficult problem. These lines are usually along the public highway, in danger of being broken by vehicles, and subject to a varying temperature which makes it almost impossible to keep them in perfect repair. The larger lines are

easily repaired with airtight clamps, and when once repaired seldom need attention. Not so with the small lines. They need constant attention. A regular patrol at frequent intervals is necessary. This will reduce the waste to a minimum. I am glad to say that at present a majority of the gas companies and manufacturers keep men employed for this purpose. These men are usually attentive to their work and very properly report to me any leaks they may notice on lines in their territory that are without care. I have thus been able to do more effective work along this line than in any former year. Previous to this year, there was no law prohibiting pipe line waste, and, at my suggestion, the last General Assembly (1899) enacted the following law, to wit:

An act regulating the use, maintenance and operation of natural gas pipe lines and machinery, apparatus and equipments used in the transportation and distribution of natural gas, providing penalties for its violation, and declaring an emergency.

[Approved February 23, 1899.]

Section 1. Be it enacted by the General Assembly of the State of Indiana, That it shall be and is hereby made the duty of the Natural Gas Supervisor of the State of Indiana, upon the discovery of any leak in any pipe line for the transportation of natural gas, or in any machinery, apparatus, appliance or device used in the regulation or distribution thereof, to forthwith notify, in writing, the owner or superintendent of said pipe line, machinery, apparatus, appliance or device, to have the same repaired within two days from the time of receipt of said notice. In case such leak has not been repaired within two days from the time of receiving such notice, it will be the duty of said Natural Gas Supervisor to make such repairs as may, in his judgment, be necessary to stop said leak; and such Natural Gas Supervisor shall have a lien upon said pipe line and all wells with which the same may be connected, for the cost of making such repairs, for the enforcement of which, with all costs of suit, and a reasonable attorney's fee, an action may be maintained by him in any court of competent jurisdiction.

In case of any pipe line, machinery, apparatus, appliance or device, owned by a corporation, partnership, or by a non-resident or absentee from the State of Indiana, the notice herein provided may be served upon any person in charge of such pipe line.

Section 2. An emergency exists for the immediate taking effect of this act, and the same shall therefore be in full force and effect from and after its passage.

Though I have not had occasion to enforce the penalty provided for the violation of this act, it has rendered me very effective aid. A large

part of the waste from pipe lines comes from negligence on the part of the superintendents of gas plants or field men, and one notice, as provided by law, has, to date, been sufficient.

THE OIL INDUSTRY AND NATURAL GAS.

The Indiana oil field is on the northeastern border of the gas field, and embraces parts of Adams, Jay, Blackford, Wells, Grant and Huntington counties. This is distinctively oil territory, and, while its development has involved the waste of a little gas in some localities, the amount has been insignificant compared with the value of the oil. Generally not enough gas is produced to operate the wells, pipe lines to the gas field being necessary to supply gas for drilling and pumping purposes. The oil territory is contiguous to the gas field, and it is sometimes difficult to define the boundary line between the two. Frequently wells drilled near it produce both gas and oil. The present price of oil tempts some oil companies to drill in gas territory; however, since the Supreme Court of the State has decided the law prohibiting the waste of gas from oil wells constitutional, most companies have shown a disposition to obey its provisions. Immediately after the court gave this decision, March 12, 1898, forty wells in Madison, Delaware and Blackford counties, producing both products, were closed, and have remained so to date. There has not been a well drilled for oil in Madison or Delaware counties for nearly two years. In Blackford and Grant counties it is different. Each of these counties, though embracing the most productive gas areas in the field, contains quite an amount of distinctively oil territory. Occasionally a well produces both products, and where the gas can not be separated from the oil and used legitimately, it is necessary to close the well.

I have closed nine wells during the past year to protect the natural gas industry, one of which was by injunction. Of course some were closed voluntarily and without even a notice.

NATURAL GAS LAWS AMENDED.

The General Assembly of 1899 amended the law prohibiting the waste of natural gas and oil from wells as follows, to wit: "Section 3. Any person violating any of the provisions of this act shall be guilty of a misdemeanor, and, upon conviction thereof, shall be fined in any sum not less than twenty dollars nor more than two hundred dollars, to which may be added imprisonment in the county jail not less than ten days nor more than sixty days; and each day during which such violation shall continue shall constitute a separate offense." Page 82,

Acts 1899. This amendment makes the law much more effective and its enforcement much less difficult than formerly. The greatest objection to the law, as originally enacted, was that it involved the tedious delay of a civil action, which meant much, when millions of feet of gas were escaping into the air daily.

A BRIEF SUMMARY.

1. During the early history of the field but little attention was given to its condition. It was the prevailing idea that the supply of gas was inexhaustible. Statements to the contrary were branded as false and made in the interest of gas companies who desired to advance rates. Thirteen years have wrought a change in the public mind. There are but few, indeed, at present, who refuse to face the true condition of the field. Information regarding the progress of development, the advance of the salt water, capacity of wells, rock pressure, etc., is eagerly sought by manufacturers, gas companies and private consumers alike.

2. Practically all the territory in the field is either under lease or is controlled by territory that is leased. More lines have been laid and wells drilled during the year 1899 than any year previous. The tendency is to enlarge the main supply lines, parallel field lines and more completely occupy the territory. Most of the wells drilled during the past year show salt water. Five new compressing or pumping stations have been built since the last report, and the capacity of five has been increased, making nineteen stations in the field. A number of small stations will be built by manufacturers and cities in the gas field this year.

3. The condition of the field can be best understood if divided into two sections, with an east and west line touching the south boundary of Hamilton County. The section south of this line contains about 850 square miles. In much of this section the gas rock is hard and thin and the wells small compared with those in the north section.

4. Where reference is made to the Indiana natural gas field, the north section is usually in mind. It supplies most of the pipe line cities, and in it the gas belt factories are centered. It contains, approximately, 2,850 square miles. On account of the heavy pipe line draught on the border of this section, and the extension of the various lines from year to year, it presents three well-defined divisions. First, an outer zone, in which the wells are either exhausted or the rock pressure is below that of the pipe lines. It contains about 1,400 square miles. Second, a middle zone, from which a majority of the pipe line

cities and gas belt factories get their fuel. It has an area of about 1,350 square miles. Third, the center of production, or that part of the field not invaded by pipe lines. It has for a center a point a little northeast of the northwest corner of Delaware County, and contains about 100 square miles.

5. While an occasional "gusher" has been reported during the past year, the records of over 300 wells, old and new, show a decline in the volume of flow. The average rock pressure of all that part of the north section, except the outer zone, is 155 pounds. The rock pressure in the undeveloped part of this section (100 square miles) varies from 170 to 210 pounds.

6. There has not been a well drilled for oil in Madison or Delaware counties for nearly two years. I have closed nine wells during the past year that were producing both gas and oil, one of these by injunction.

7. There is much anxiety on the part of residents of the gas belt regarding the future of the manufacturing industry. Though conditions, to a certain extent, warrant this, I believe that a majority of the factories will successfully adopt other fuels when it becomes necessary. Manufacturers are disposed to find another fuel rather than a new location.

8. Regarding the future of the gas field, I will say, as I did in my last annual report, that the history of other gas fields, the past history of this and all its present conditions justify the statement that the supply of gas is failing and will finally be exhausted.

REPORT OF STATE SUPERVISOR OF OIL INSPECTION.

INDIANAPOLIS, IND., January 8, 1900.

Prof. W. S. Blatchley, State Geologist:

SIR—In obedience to Section 5154, R. S. 1881, I have the honor to submit herewith the report of this department for the year 1899. The total inspection of petroleum oils for illuminating purposes amounted to 300,867 barrels. Of this number, 300,447 barrels were approved for use as an illuminant, and 420 barrels were rejected for illuminating purposes.

There have been erected during the year 16 new tank stations, where bulk oil may be stored. In 102 cities and towns of the State are located storage tanks, for handling refined oils. This increase of bulk stations largely increases the work and expense of the Department, and I desire to express my appreciation of the hearty support and efficiency of the Deputy Supervisors, who have so willingly co-operated with me in the enforcement of the law.

There have been no accidents reported to this office, resulting from the use of coal oil as an illuminant. The only accidents reported were those where people used gasoline instead of oil for burning in their lamps. The mistake is often made by dealers selling gasoline for coal oil, and in one case during the year with fatal results.

The legislature of 1899 enacted a law regulating the use of oils for illuminating purposes in mines. This law was asked for, on the part of the miners of the State, that would compel the use of an oil for illuminating mines free from smoke, and for that purpose, the law provides for inspection of all oils intended for use in the mines of the State. The oil must be a pure animal or vegetable oil, or other oils as free from smoke as a pure vegetable or animal oil, the specific gravity of which must not exceed 24 degrees Tagliabue at 60 degrees temperature. Every effort has been made to strictly enforce this law. The only trouble experienced has been with jobbers in oils from outside of Indiana, who have repeatedly sold oil to dealers in the State, claiming that their oil complied with the requirements of the law, and therefore needed no inspection. In each case of this kind we have been compelled to reject the oil on account of its failure to stand the gravity test of under 24 degrees Tagliabue.

You will find herewith a table showing the inspection of miners' oil since the taking effect of this act. Also tables showing the inspection of all petroleum oils by stations and by months, and a list of the Deputy Supervisors of Oil Inspection.

Respectfully submitted,

W. C. ZARING,

State Supervisor of Oil Inspection.

DEPUTY SUPERVISORS OF OIL INSPECTION.

Address, E. H.	Lafayette, Ind.
Bell, T. E.	Hammond, Ind.
Blatchley, F. H.	Bainbridge, Ind.
Boltz, J. H.	Winchester, Ind.
Bowman, M. J.	Madison, Ind.
Cooper, W. V.	Evansville, Ind.
Crabbs, O. W.	Muncie, Ind.
Davenport, J. B.	Elkhart, Ind.
Derr, Walter.	South Bend, Ind.
Dorsey, C. B.	New Albany, Ind.
Dorsey, W. C.	Terre Haute, Ind.
Johnston, J. M.	Logansport, Ind.
Lane, C. R.	Ft. Wayne, Ind.
Lockwood, C. W.	Peru, Ind.
Markley, G. W.	Crawfordsville, Ind.
Schutt, M. A.	Michigan City, Ind.
Weems, R. F.	Vincennes, Ind.
Zehrunge, P. H.	Cambridge City, Ind.

Table showing the total number of barrels petroleum oil inspected at each station for the year 1899:

	<i>Bbls.</i>
Anderson	333
Angola	2,277
Argos	366
Attica	1,797
Auburn	1,012
Aurora	2,613
Batesville	1,300
Bedford	1,553
Bloomfield	1,160
Bloomington	1,602
Bluffton	1,922
Bourbon	1,208
Brazil	2,595
Bremen	496
Brookville	1,399
Butler	571
Cannelton	74

	<i>Bbls.</i>
Chicago, Ill.....	180
Cincinnati, O.....	3,782
Cleveland, O.....	6,247
Columbia City	1,166
Columbus	2,644
Connersville	2,258
Corydon	471
Crawfordsville	3,567
Crown Point	1,293
Danville	1,621
Danville, Ill.....	213
Decatur	1,419
Delphi	1,398
Elkhart	3,996
Elwood	212
Evansville	19,454
Fort Wayne	8,888
Fowler	1,806
Frankfort	2,291
Franklin	1,587
Garrett	676
Greencastle	1,262
Greensburg	1,234
Greenfield	928
Goshen	2,240
Hammond	3,965
Hartford City	202
Hobart	415
Huntingburg	920
Huntington	3,115
Indianapolis	53,617
Jeffersonville	3,399
Kendallville	2,077
Knox	459
Kokomo	2,674
Lafayette	9,786
Lagrange	1,248
Laporte	2,365
Lebanon	2,479
Liberty	716
Ligonier	1,114
Lima, O.....	5,121
Logansport	6,320
Louisville, Ky	5,007
Madison	3,928
Mansfield, O.....	2,374
Marion	2,078
Martinsville	1,328
Michigan City	2,237

	<i>Bbls.</i>
Monticello	190
Mt. Vernon	334
Muncie	1,988
Nappanee	1,194
New Albany	3,842
New Castle	1,683
Newport	224
New Paris	30
North Manchester	1,317
North Vernon	126
Paoli	518
Peru	3,017
Pierceton	487
Plymouth	1,279
Porter	761
Portland	1,978
Poseyville	558
Princeton	1,692
Rensselaer	157
Richmond	3,715
Roachdale	122
Rochester	1,476
Rockport	491
Rockville	1,893
Rushville	1,800
Salem	1,176
Seymour	2,365
Shelbyville	2,092
South Bend	8,477
Spencer	460
St. Joe	283
Sullivan	1,653
Tell City	610
Terre Haute	11,847
Toledo, O.	2,866
Topeka	170
Union City	2,184
Valparaiso	1,657
Veedersburg	1,253
Vincennes	6,800
Wabash	1,900
Walkerton	1,202
Warsaw	1,604
Washington	2,878
Westfield	655
Whiting	7,719
Winamac	90
Total	300,867

Table showing the number of barrels of petroleum oil inspected in each month of 1899:

January	35,739
February	26,921
March	24,933
April	18,742
May	15,634
June	15,417
July	13,337
August	18,675
September	22,825
October	33,225
November	33,679
December	41,740
Total	300,867

Table showing number of barrels of miners' oil inspected from May 1, 1899, to January 1, 1900:

	APPROVED.	REJECTED.	TOTAL.
Ashboro.....	2	1	3
Ashville.....	3		3
Brazil.....	179	29	208
Carbon.....	23	1	24
Caseyville.....	3	5	8
Center Point.....	3		3
Clinton.....	12	14	26
Del Carbo.....	5	5	10
Evansville.....	79		79
Hoosierville.....		2	2
Hymera.....	3	3	6
Indianapolis.....	407	6	413
Jackson Hill.....		8	8
Knightsville.....	5	3	8
Perth.....	4	1	5
Shelburn.....	3	1	4
Staunton.....	5		5
Terre Haute.....	85	3	88
Washington.....	188		188
Total barrels inspected.....	1,009	82	1,091

THE
DRAGONFLIES
OF
INDIANA.

BY
E. B. WILLIAMSON,
BLUFFTON, IND.

LETTER OF TRANSMITTAL.

BLUFFTON, IND., December 15, 1899.

Mr. W. S. Blatchley, State Geologist, Indianapolis, Ind. :

DEAR SIR—I have the honor of sending you herewith a paper on the Odonata of Indiana, prepared at your request and according to your suggestions. Your wish was that this paper might include keys and descriptions of the species of dragonflies found in the State, thus furnishing students a means of identifying their specimens. While preparing the manuscript the compiler has tried to keep in mind the needs of those who may wish to know these beautiful and interesting insects by name.

Yours, very respectfully,

E. B. WILLIAMSON.

INTRODUCTION.

During the autumn of 1898, Mr. R. J. Weith and the writer prepared a list of the dragonflies known to occur in Indiana. This paper recorded 83 species for Indiana, giving for each the locality, date of capture, and collector's name. When this list was sent to Mr. Blatchley he requested that it be enlarged to include descriptions of the various species. Mr. Weith kindly gave me permission to use his notes and the present compilation has been prepared. I have attempted to give short descriptions of the species known to occur within the State, as well as of those which are most likely to be found in the future. The present list includes 84 species as positively recorded; one species of *Enallagma* is described as new. But little collecting has been done in the State, and the number is certain to exceed a hundred.

Thanks are due a number of persons for aid in the preparation of this paper. Dr. Calvert and Mr. Hine have given me help in the identification of material and in other ways. By Dr. Calvert's kindness I am privileged to use his key for nymphs as published in his Philadelphia Catalogue. Mr. Adams has furnished me a list of Illinois species as known to him. Mr. R. J. Weith, Elkhart, Mr. C. C. Dean, Bluffton, and Mr. Blatchley, have furnished many of the records. I have given these collectors credit under each species. The bulk of Mr. Weith's material was examined and a list of the species prepared by Dr. Calvert. Mr. J. B. Parker, instructor in English in the Ohio State University, has kindly prepared the etymology of the scientific names. Dr. Calvert also has helped with this work. The etymology of *Macromia*, as given, is according to his advice, the name probably referring to the equally long tarsal nails. Throughout the paper the writer, because of his inability in many cases, has not attempted to point out the application of the scientific names. To my late friend and instructor, Professor Kellcott, I owe all the interest and pleasure I have found in collecting and observing these insects. In the compilation of the paper free use has been made of the writings of different authors on the Odonata whenever it has seemed desirable to do so.

THE DRAGONFLIES OF INDIANA.

BY E. B. WILLIAMSON, BLUFFTON, IND.

“ * * * * *
To-day I saw the dragonfly
Come from the wells where he did lie.

“ An inner impulse rent the veil
Of his old husk: from head to tail
Came out clear plates of sapphire mail.

“ He dried his wings: like gauze they grew;
Thro' crofts and pastures wet with dew
A living flash of light he flew.”

—Tennyson.

The order *Odonata* (Gr. *odous*, a tooth, probably referring to the toothed mandibles), including the insects commonly called dragonflies, snake-feeders, snake-doctors, spindles, devil's darning needles, etc., may be briefly characterized as follows: Metamorphosis incomplete, that is, the young, from the hatching of the egg until the adult stage is reached, are active, the larval and pupal stages are not sharply defined, and at no time in its life history does the insect pass into a quiescent state corresponding to the pupa of a butterfly, bee, or other of the more highly specialized orders. Nymph aquatic. Imagoes mandibulate, that is, mouth parts adapted to biting. Wings four, membranous, netted-veined, the hind wings as large or larger than the front wings; all the wings usually provided with an opaque colored spot, the pterostigma, near the apex. Tarsi three-jointed. Antennae awl-shaped, inconspicuous.

Dragonflies are easily recognized and can hardly be mistaken for insects of any other order. One or more of the characters given above will serve to separate them from the Mayflies, the stoneflies, and some of the neuroptera to which they bear a slight resemblance.

The order *Odonata* is naturally divided into two suborders, three families and seven subfamilies.

ODONATA.

Suborder *Zygoptera*.Family *Agrionidae*.Subfamily *Calopteryginae*.Subfamily *Agrioninae*.Suborder *Anisoptera*.Family *Aeschnidae*.Subfamily *Gomphinae*.Subfamily *Cordulegasterinae*.Subfamily *Aeschninae*.Family *Libellulidae*.Subfamily *Cordulinae*.Subfamily *Libellulinae*.

These groups will be defined in the key to the genera. In the family *Agrionidae* belong our small slender species. The largest species occurring in the State belongs to the *Aeschnidae*, a family which includes some of the strongest fliers. The *Libellulidae* occurring in the State are mostly large species, though two or three are quite small, but the body is always robust and not slender and thread-like, as in most of the *Agrionidae*.

Life History.—The egg hatches in fresh or brackish water. From this time till the final change to the adult winged stage the insect is known as a nymph or larva. It leads an active predaceous existence, feeding on all forms of aquatic life which it can overpower. "The nymphs, as well as the adults, exhibit the malignant side of life that lived and sported about the marshes of the remote Tertiary period."—Kellicott. Some of the *Aeschnines* are known to be cannibalistic. Stefanelli has observed that nymphs of *Aeschna cyanea*, a European species, at night come out of the water and destroy the newly emerged imagoes of the same species.

Nymphs are known to feed on small fish. A European observer reports that 50,000 young fish were placed in a pond in the spring. In September only 54 remained, but there were immense quantities of dragonfly larvae. An *Agrionine* nymph was seen by the writer clinging to the abdomen of a dead catfish, upon the flesh of which it was evidently feeding. Within an hour a nymph of *Aeschna constricta* killed and partially consumed seven toad tadpoles, measuring about 13 mm. in length. Nymphs of larger species feed on nymphs of smaller species and all fall prey to fish, salamanders and crayfish.

The nymphs of the suborder *Zygoptera* propel themselves through the water by a serpentine motion. Those of the suborder *Anisoptera* expel water from the rectum and thus drive themselves forward.

The nymph undergoes successive moults, increasing in size and progressing in its development. Finally it crawls from the water upon

some object near at hand. After some time the skin splits across the top of the head and along the back and the adult or imago emerges, leaving the exuvia clinging to its support.

The imago for some time after its transformation is pale; the wings and body gradually expand to their full extent; and finally the bright colors of the mature insect appear. These pale, newly emerged individuals are known as teneral. The collector can recognize them as they fly by their shimmering wings and weak flight. The bodies and wings are soft and the colors are pale, obscure yellowish, bluish or brown. Individuals of some species, as they grow older, become covered with a whitish or bluish powder which may entirely obscure the earlier colors. This is especially true of the males. Such individuals are said to be pruinose.

With its advent into an aerial life our dragonfly becomes one of the most beautiful of insects. Strong, rapacious and daring, possessed of striking individualities, they offer the rarest sport to the collector who frequents their haunts, observing the many idiosyncrasies of these lords of insect creation. Here little *Perithemis domitia* goes quietly and politely about his business, flitting from lily-pad to sedge stem, making his observations on the beauty of the day and the large number of diptera which are abroad. *Plathemis lydia* comes along, rudely inquiring into everyone's affairs, for our *Plathemis* is either a restless busybody or an immaculate dandy who displays himself on some sunny log or rock. Then piratical *Anax junius* rushes up, makes a dash at *Plathemis*, glances at *Perithemis* and passes out of sight into the woods along the shore. And in the sedges all this time myriads of emerald and sapphire forms fight and make love in their different ways.

The food of the imagoes consists almost entirely of other insects, though some are known to occasionally eat the flesh of dead animals. Mr. F. S. Webster has observed *Libellula auripennis* feeding on fresh crocodile flesh. Of the insects eaten diptera are more preferred than any other order, though all soft bodied insects seem to fall prey to their ravenous appetites. Larger species eat their smaller relatives. Leafhoppers and other Hemiptera and Lepidoptera are consumed. *Mesothemis simplicicollis* may occasionally be seen to pick some resting moth from a weed or grass stem. Mr. J. L. Graf, Pittsburg, saw a dragonfly attack and overpower a large *Papilio*. The writer once took a female of *Cordulegaster obliquus* which was holding a large wasp in its mandibles.

The adult dragonfly has little to fear from other insects. A large robber fly has been observed carrying a teneral *Sympetrum rubicundulum* which it had doubtless killed. Birds, however, eat large numbers of Odonata. The skin of a female pigeon hawk collected in Cape May County, New York, now in the Carnegie Museum, bears this label: "Stomach full of dragonflies." The smaller hawks, shrikes, cuckoos and

flycatchers are the birds which most frequently feed upon Odonata, but none of these species at any time make them their exclusive article of diet. Fish occasionally dash at female Libellulines when they are ovipositing, but the writer has never seen the dragonfly injured by these attacks. Agrionines, which habitually descend beneath the water to oviposit, are no doubt frequently eaten by sunfish. Spiders occasionally entrap teneral dragonflies. Dr. Calvert records a young spider, *Dolomedes secpunctatus*, feeding upon the soft parts of *Isechnura verticalis* and *Nehalennia posita*. In the webs of a large black and yellow spider, *Argiope*, the writer has found the remains of *Argia violacea*, *Libellula pulchella*, *Sympetrum rubicundulum* and *Mesothemis simplicicollis*. In the case of *Argia violacea* alone, the dragonflies were fully matured. The nymphs as well as the adults, from their feeding habits, are freely exposed to the entrance of intestinal parasites. Red mites, *Acarina*, are frequently found on the under surface of the thorax or abdomen of imagoes.

In pairing, the male dragonfly grasps the female by the prothorax (*Agrionidae*) or by the occiput and rear of the head (*Aeschnidae* and *Libellulidae*) with his abdominal appendages. So held, the female curves her abdomen forward beneath her thorax till the vulva (vagina) at the ventral apex of the eighth abdominal segment is brought into contact with the accessory genital organs of the male, which are situated on the ventral surface of the second abdominal segment. Before copulation, the male, by curving his abdomen, transfers the sperm from the opening of the vas deferens on the ventral surface of 9 to the vesicle on the ventral surface of 2. The females usually proceed to ovipositing immediately after copulation. The *Agrionidae*, the *Aeschninae*, and probably the *Petaluroid Gomphinae* and the *Cordulegasterinae* place their eggs within the tissues of aquatic plants. Some of the *Agrionines* (*Lestes*, *Argia*, *Enallagma*) frequently descend beneath the water during oviposition, backing down a submerged stem or other support and placing the eggs successively at greater depths. At such times the male may or may not retain his hold of the prothorax of the female. The ovipositor is formed by the prolongation and modification of the vulvar lamina, the apex of the sternum of the eighth abdominal segment. In all the forms with an ovipositor, excepting the *Cordulegasterinae*, two flaps which lie on either side of the ovipositor are developed from the sternum of the ninth abdominal segment. These are the genital valves. In the *Libellulidae* and the *Gomphinae*, excepting the *Petaluroids*, there is no ovipositor and the eggs are either dashed into the water or are attached by a gummy matter which surrounds them to submerged objects. Oviposition in plant tissues is known as endophytic; when the female dips her abdomen into the water and the eggs are left either floating or attached to some object, it is known as exophytic oviposition. In endophytic or exophytic oviposition the male may or may not retain his hold of the prothorax or head of the female.

Many species may be observed to pair more than once. This is true of *Libellula pulchella* in which copulation and oviposition follow in immediate succession for several times. On these occasions each act of copulation may take place with a different male. The possibility of range of individual variation of the offspring of each female is thus greatly increased.

The development of the egg and the hatching of the nymph require from six to twenty-one days, depending on the species.

Geological and Geographical Range. More than 100 species of fossil Odonata have been named. These belong to 27 genera. Thirteen of these genera are extinct, while the remaining number are represented by species living in the world to-day. All of the seven subfamilies are represented by extinct species. The oldest remains are those of the *Gomphinae*, *Aeschninae* and *Libellulinae* from the Lower Lias in England and Germany. The *Calopteryginae*, *Agrioninae* and *Cordulegasterinae* appear first in the Oolite, the lithographic slates, in Germany. The *Cordulinae* occur first in the Eocene in Italy.

Dragonflies are found all over the world within the limits of permanent human habitation. The northern and southern limits, as far as known, are 70° N. and 55° 30' S.

Kirby, in the preface to his Synonymic Catalogue, says: "Comparatively few recent species of the suborder Odonata are known at present—about 1,800, or rather more than half as many as those belonging to the least numerous classes of Vertebrata, such as Mammalia or Reptilia; and very much fewer than those of the larger families of such orders of insects as Coleoptera or Lepidoptera." Calvert, in his Philadelphia Catalogue, places the number of species at 1,922, distributed in 321 genera. The Neotropical species (Tropical Mexico, Central and South America, adjoining islands, the West Indies) number 570; Nearctic (America, north of Mexico) 258; Palearctic (Europe, Asia, north of the Himalayas and west of the Indus, Arabia and Africa, north of the Tropic of Cancer, and the adjoining islands) 292; Ethiopian (Africa and Arabia south of the Tropic of Cancer, and adjacent islands) 217; Oriental (Asia, east of the Indus and south of the Himalayas, Ceylon, Sumatra, Java, Borneo and the Philippines) 436; Australian (Australia, Tasmania, New Zealand, New Guinea, Celebes and the intervening islands) 193; and Polynesian (the islands of the Pacific from the Australian Province to the Sandwich Islands, the Marquesas and the Low Archipelago) 42. These numbers, as given by Dr. Calvert, represent the total number of species recorded for each zoo-geographical area. A large number of species may occur in two or more of these areas. *Pantala flavescens*, for example, is found in Asia, Africa, America and islands of the Pacific.

Since Dr. Calvert made the above estimates, no less than 20 genera and 150 species have been described as new. The number of dragonflies now known to live in the world is about 2,100. The number recorded for Great Britain is 45, for France 70, and for all Europe 120. Professor Kellicott and his associates have taken 100 species in the State of Ohio. Even a larger number will doubtless be found to inhabit Indiana. The number of species of butterflies and of dragonflies to be found in the State is very nearly the same. That this number is decreasing for the Odonata, however, there can be little reasonable doubt. The draining of marshes and lakes, especially in the northern part of the State, and the pollution of many of the streams by sewage and the waste from oil wells and manufactories, will reduce the habitable areas, and thus tend to condense the species at more favorable locations. Perhaps this may explain the sudden appearance at some suitable locality of one or more species never before observed there. Under such conditions many species are certain to disappear. One man's lifetime is not sufficient to observe any appreciable decrease perhaps, but if collections are made and reliable notes kept, these will some day prove of great value and interest in showing to what extent man's occupation of the country has affected the natural conditions originally existing there. That small streams are disappearing, that marshes are becoming smaller and lakes shallower, that in the Upper Wabash the fish are dying and the Unionidæ have almost disappeared—these are well known facts, whatever may be the cause or causes, and surely the Odonatological fauna, depending so intimately upon the streams, marshes and lakes, must be most deleteriously affected.

Writings on Dragonflies.—Hagen's *Synopsis of the Neuroptera of North America*, Smithsonian Institution, 1861, contains descriptions of most of the species found in Indiana. This work can occasionally be purchased from second-hand book dealers, both at home and abroad. Calvert's *Catalogue of the Odonata of the Vicinity of Philadelphia, with an Introduction to the Study of this Group of Insects*,* contains a very full account of the anatomy, life histories and relationships of the Odonata, a bibliography, and descriptions, with keys to genera of imagoes and nymphs of the species known and presumed to occur within a radius of 20 miles from Philadelphia. Banks' *Synopsis, Catalogue and Bibliography of the Neuropteroid Insects of Temperate North America*,† gives keys to the genera, a list of the species and a bibliography to the literature of the subject. Kellicott's *Odonata of Ohio*‡ contains keys to the genera and species taken in Ohio, and full descriptions of the species. Most of the monographic work on the Odonata has been done by Baron de Selys-Longchamps, whose writings have been published in French. Bibliographies of his writings and

* Transactions American Ent. Soc., 1893.

† Transactions American Ent. Soc., 1892.

‡ Special papers of the Ohio Academy of Sciences, No. 2, 1899.

of those of other authors will be found in the works by Calvert and Banks mentioned above. Notes and descriptions appear from time to time in the entomological magazines of the country, especially the *Canadian Entomologist*, London, Ontario, Canada; the *Entomological News*, Philadelphia; and *Psyche*, Cambridge. Only three papers have been printed that deal directly with Indiana dragonflies. Thomas Say, in 1839, *Acad. Nat. Sci., Phila.*, Vol. VIII, pp. 9-46, published a paper entitled *Descriptions of New North American Neuropterous Insects, and Observations on Some Already Described*. Seventeen species are recorded for Indiana. Professor Kellicott, in the *Proc. Ind. Acad. Sci.*, 1895, under the title *The Odonata*, lists 14 species, represented in two collections sent him by Professor Eigenmann. The specimens were collected at Turkey Lake, Kosciusko County, during July and August, 1895. In the Annual Report, Department Geology and Natural Resources, Indiana, W. S. Blatchley, 1897, the writer printed a short list of 25 species collected at Shriner and Round lakes, Whitley County, on September 2-4, 1897.

COLLECTING AND PRESERVING.*

Nymphs.—Professor Needham, in the *Canadian Entomologist* for April, 1897, pp. 94-96, gives directions for collecting nymphs, which we may quote in part: "The nymphs, which are all aquatic, have an interesting distribution in depth. Those of the *Agrionidae* and of most *Aeschninae* cling to floating or submerged vegetation. These, at least, every aquatic collector has seen. Those of the *Libellulidae* sprawl upon the bottom amid fallen trash. Those of *Gomphinae* burrow shallowly along beneath the film of sediment that lies on the bottom, with the end of the abdomen turned up for respiration.

"It is very easy to collect them, especially in the spring. A garden rake with which to draw ashore the stuff to which they cling, and a pail of water in which to carry them home, is all the apparatus desirable at that season. Later, when a new growth of weeds is rooted fast to the bottom, the rake will have to be exchanged for a water-net. Withdrawn from the water, the nymphs render themselves evident by their active efforts to get back, and need only to be picked up. The places apt to yield the best collecting are small permanent pools, shallow inlets in the shores of lakes, and the places where the trash falls in the eddies of streams.

"They are quite as easily reared. I have found common wooden kits and pails half-filled with water, with screen or netting covers, entirely satisfactory. A number of nymphs, if near one size, may safely be kept

*See Bull. of the U. S. Nat. Mus., No. 39, Part O, "Directions for collecting and rearing dragonflies, stoneflies and Mayflies," by James G. Needham, Ph. D.

together (excepting only a few notoriously cannibalistic *Aeschninae*, e. g., *Anax junius*), and, if not grown, may be fed upon such small insects as a net will gather in any pond. (Small insects, which may be swept from grass and herbage with the beating net, will also serve them as food.) A good square meal once a week will keep them thriving. The water should be reasonably clean. Three things should be carefully observed: (1) there must be a surface up which they can climb to transform; if the sides of the kit are too smooth put in some sticks; (2) there must be room enough between the netting cover and the water for complete expansion of their wings; (3) they must remain out of doors where the sunshine will reach them. The last point especially is essential to success. But there is an easier way to do it, and one which, when a species is very common, will prove entirely satisfactory. If, when a species is becoming common, one will go to the edge of the water it frequents, at the time of its emergence, one may find nymphs crawling from the water, others transforming, imagoes drying their wings, and others ready to fly, and may thus obtain in a few minutes the material necessary for determining nymph and imago. The unfortunate thing about it is that many of the larger species transform very early in the morning, and to take such advantage of them one must be on the ground between daybreak and sunrise.

“Eggs also are easily obtained. If the ovipositing female be captured, held by the fore wings, leaving the hind wings free, and ‘dipped’ by hand to the surface of clean water in a vial or a tumbler, an abundance of eggs will usually be liberated. Eggs of those species which possess an ovipositor and which place them within the tissues of plants, may be obtained by collecting the stems in which they have been inserted. Eggs and nymphs should be dropped in boiling water for a minute and then preserved in alcohol.”

Imagoes.—During a favorable year in Indiana dragonflies may be found flying as early as the first of April, and as late as the first of November. The species are most numerous during the month of June. While certain species fly almost the entire season, others are to be found during only a short period. *Ischnura verticalis* and *Nehalennia posita*, two of the smallest species occurring in the State, and *Anax junius*, one of the largest, have the greatest seasonal range, appearing first, and being among the last to disappear. While most of the *Agrionidae* are easily captured, many species of the *Aeschnidae* and *Libellulidae* will be found to tax the skill and patience of the collector to the highest degree.

During the collecting season dragonflies may be found everywhere. Certain species will be found only in a certain environment, while others appear at home almost anywhere. *Heterina americana*, for example, never ranges far from the water’s edge, preferring the swift ripples of some stream, and being found but rarely about ponds or lakes. *Libellula*

pulchella, on the other hand, flies over every lake and puddle, explores every stream, from some twig or weed stem watches the traffic along a hot country road, and catches diptera in the open woodland. Small lakes with shores margined by rushes and sedges will prove the richest in the number of species, but the streams, fields and woods will yield others which seldom, if ever, visit the lakes. About Shriener and Round lakes, in Whitley County, 46 species have been observed. This is as large a number as has been recorded for Great Britain.

Males and females of the same species may differ greatly in their habits. The females of many of the *Libellulinae* and *Gomphinae*, especially, may conceal themselves among the rank herbage bordering some stream or lake, going only to the water to oviposit, while the active males of the same species constantly patrol the shore on the lookout for the females and for their insect prey. Immature males also of such species may frequent sheltered retreats. High winds drive species from their accustomed resorts, when they may seek shelter in deep woods, houses, etc. During the spring of 1899 Mr. J. L. Graf took four species which entered his home in Pittsburg—*Gomphæschna furcillata*, *Epiæschna heros*, *Tachopteryx thoreyi* and *Macromia illinoiensis*. *Calopteryx maculata* and *Aeschna constricta* have been found in houses by the writer. *Epiæschna heros* is the only species, however, which seems to habitually seek protection from the weather in this way. Rarely great numbers of a species may appear. *Libellula quadrimaculata* frequently migrates in great flocks which darken the sky. Other species have also been observed in migratory swarms.

In the collecting and preserving of specimens the same general rules that apply to butterflies will hold here. It is impossible to repeat the carefully written and illustrated articles of several authors on this subject, and the student is referred to the following works: (1) *Directions for Collecting and Preserving Insects*, by C. V. Riley. Part F, Bull. U. S. Nat. Mus., No. 39, 1892; (2) *Taxidermy and Zoological Collecting*, by William T. Hornaday; Chas. Scribner's Sons, N. Y., contains a chapter by W. J. Holland on *Collecting and Preserving Insects*; (3) *The Butterfly Book*, by W. J. Holland, Doubleday & McClure Co., N. Y. This contains an illustrated chapter on collecting and preserving butterflies. In addition to the directions to be found in the above and other works, a few hints applicable especially to dragonflies may be given.

In the field, specimens may be carried in an ordinary cyanide bottle for two or three hours with safety. If they are left too long in the presence of the fumes of potassium cyanide, however, the colors are irrevocably ruined. During a day's trip the contents of the bottle may be placed from time to time between sheets of glazed cotton or in paper envelopes, in a cigar box. In this way a large number of specimens can be carried safely and conveniently.

When specimens are papered or placed in envelopes these should be of soft paper, and the specimens, after being dried, should be packed loosely to avoid crushing and breaking. If the envelopes are of stiff, heavy paper, there is danger of the eyes and other parts being pressed out of shape. Pinned specimens should have a bristle, pin or wire passed from the ventral surface of the thorax, between the pro- and mesothorax, or from the nasus, through the abdomen to its tip. The bristle should not pass beyond the abdomen, nor should it press the abdominal appendages from their natural position. The supporting wire or bristle prevents the otherwise almost certain breakage of pinned specimens. When expanding *Agrionidae*, in order to have a nicely proportioned specimen, the front wings and hind wings should be so placed that a line between them is at right angles to the body. In species of other families which have the base of the hind wings dilated, as in *Tramea* and *Pantala* for example, the hind wing should be drawn forward till the entire wing lies flat, and the front wings should then be placed just in advance of the hind wings. The abdomen should be straight, and the thorax and abdomen should lie in the same line, with the abdomen neither drooping nor upcurved.

The colors of dragonflies are likely to fade, and this is especially true of the bright blues and greens. The reds and yellows are most beautifully preserved in some species. Metallic coloration, as in the genus *Colopteryx*, is permanent. In larger species the colors may sometimes be retained with some degree of success by removing the thoracic and abdominal contents through a ventral longitudinal slit cut for the purpose, and by then replacing the parts removed with a small roll of paper in the abdomen and a small piece of cotton in the thorax. In performing this operation care must be exercised not to scrape or injure the body wall. Keeping specimens alive until the intestinal contents have been discharged has also been recommended. Specimens dropped into 95 per cent. alcohol as soon as they have been killed in the cyanide bottle, retain all their colors perfectly if not exposed to continuous light. Papered specimens, if the envelopes be of a loose porous paper like newspapers, may be dried very rapidly by placing them in the direct rays of the sun, if possible where there is a good draught of air. Smaller species, like the *Enallagmas*, may be almost perfectly preserved in this way. Under any circumstances, when the specimen is pinned or papered, rapid drying is most essential for the preservation of the colors. Pinned specimens should of course never be exposed to the direct rays of the sun.

Entomological supplies, pins, cork, insect cases, etc., may be purchased from a number of reputable dealers: M. Abbott Frazer, 93 Sudbury Street, Boston; Fred. Kaempfer, 88 State Street, Chicago; Queen & Co., 1010 Chestnut Street, Philadelphia; A. Smith & Sons, 269 Pearl Street, New York. The black, tempered steel pins made by

Kirby, Beard & Co., London, and for sale in this country by Dickerhoff, Raffloer & Co., Broadway, New York, are the best. Numbers 3 and 5 will be found the most convenient. In the study of specimens a small lens will be required. The No. 7 Doublet, made by Bausch & Lomb Optical Co., Rochester, N. Y., will answer for most purposes where a microscope is not required.

In the keys and descriptions which follow, the abdominal segments are represented by the Arabic numerals 1-10; the descriptions apply, unless otherwise stated, to maturely colored specimens; unless otherwise mentioned, the wings are hyaline; measurements are in millimeters; they are for average sized individuals, and may vary as much as one-sixth for particular specimens; 25 millimeters equal very nearly one inch; the length of abdomen includes the abdominal appendages; ab. and h.w. mean abdomen and hind wing respectively.

Great variations, especially in neuration, occur in some individuals, hence several specimens of a species are desirable; in identifying a species it is desirable, often necessary, to have both male and female specimens. The males are readily distinguished from the females by the stronger, more characteristically shaped abdominal appendages, and by the presence of the accessory genital organs of the ventral surface of 2. In those species which oviposit endophytically, the ovipositor is usually large and conspicuous. Many other differences exist in certain subfamilies and genera. Socalled dimorphic females exist in some genera of *Libellulinae* and *Agrioninae*. These are females which have the coloring or the neuration of the wings very different from the males or the ordinary females.

The following localities, mentioned throughout the paper, are found in the counties indicated:

- Bluffton, Wells County.
- Boot Lake, Elkhart County.
- Chapman Lake, Kosciusko County.
- Christina Creek, Elkhart County; tributary to the St. Joe River.
- Eagle Lake, Kosciusko County.
- Elkhart, Elkhart County.
- Elkhart River, Elkhart County; tributary to the St. Joe River.
- Frantz Fishpond, Wells County.
- Goose Lake, Kosciusko County.
- Indiana Lake, Elkhart County.
- Round Lake, Whitley County.
- Sbriner Lake, Whitley County.
- Simonton Lake, Elkhart County.
- Turkey Lake, Kosciusko County.

Throughout the paper species have been designated by their scientific names. Any attempt to coin or establish common names for even the large and conspicuous forms will be more confusing than to simply use the specific names of the species. *Plathemis lydia* is sometimes spoken of as the "White-bodied snakefeeder." It will be as easy and more exact to refer to it as "lydia."

The belief in the harmfulness of "snakefeeders" is almost universal—their bite is poisonous, their sting fatal, they cause deafness by flying in people's faces, they sew up the ears of truants, and their best friends and most congenial associates are snakes—copperheads and rattlers preferred. As a matter of fact, they can inflict no injury on mankind, do not act as nurses or physicians to crawling creatures, and are not only harmless but, because of their destruction of mosquitoes, deerflies and other dipterous nuisances, are really beneficial. Many questions will be asked the collector of these insects by people whom he will meet in his search for specimens; and often his answers will lead his questioners to unjust conclusions concerning his mental capacity. The writer has been compelled to listen to the following: "Are you getting snakefeeders for fish-bait?"—"to eat?"—"to use their wings to make picture frames or ornaments?"—"or is there a bounty on them?"

SYSTEMATIC CHARACTERS OF NYMPHS.

This key is copied without change by permission of Dr. Calvert from his Philadelphia catalogue.

I. Three caudal tracheal-gills (*Zygoptera*).

Legion Calopteryx.—Basal joint of antennæ thick, more than twice as long as the other six together. Median lobe of labium bifid.

Front edge of median lobe of labium bifid to form a lozenge-shaped interval between which extends basally beyond the level of the attachment of the lateral lobes. Rear of head with a tooth each side. Median caudal gill flat, shorter than the other two.

CALOPTERYX.

Front margin of median lobe of labium bifid only as far basally as the level of the attachment of the lateral lobes. Abdominal segments with a lateral membrane whose margins are denticulated. Median caudal gill a little swollen at apex.

HETERINA.

Subfamily Agrioninae.—Basal joint of antennæ hardly longer than thick, much shorter than the second or the third.

Lateral lobes of labium (excluding the terminal palp) deeply bilobed, median lobe barely bifid.

Legion Lestes.

Lateral lobes of labium (excluding the terminal palp) not deeply bilobed, median lobe entire. *Legion Agrion.*

The veins on the wing-covers will assist in determining between these two legions as in the imagoes.

II. No caudal tracheal-gills (Anisoptera).

Subfamily Gomphinae.—Antennæ 4-jointed, fourth joint rudimentary; first and second tarsi 2-jointed; labium flat, not covering the labrum or frons when closed.

First legs less distant from each other at base than are the second legs. Abdomen much less than twice as long as broad, very flat, almost circular when viewed from above. Third joint of antennæ large, flat, circular. *HAGENIUS.*

First legs as distant from each other at base as are the second legs. Abdomen at least twice as long as broad.

Middle third of front margin of median lobe of labium produced in a very short rounded lobe, with pavement teeth and a comb of flat scales. *OPHIOGOMPHUS.*

Middle third of the same straight or nearly so. *GOMPHUS.*

Subfamily Cordulegasterinae.—Antennæ 7-jointed; all tarsi 3-jointed; labium spoon-shaped, covering labrum and frons when closed, teeth on the opposed margin of the lateral lobes long, interlocking when closed so as to form a distinctly zigzag line of union. Abdomen two or three times as long as broad.

Characters of the subfamily. *CORDULEGASTER.*

Subfamily Aeschninae.—Antennæ 6-7-jointed; tarsi 3-jointed; labium flat, not covering labrum of frons when closed.

Antennæ 6-jointed.

Head broader than long; a lateral spine on 4-9, middle and inferior appendages of equal length. *EPIÆSCHNA.*

Antennæ 7-jointed; head broader than long.

Hind dorsal margin of 9 concave.

A lateral spine on 4-9, middle appendage sharply pointed. *FONSCOLOMBIA. (BOYERIA.)*

A lateral spine on 5-9, middle appendage bifid at tip.

GOMPHÆSCHNA.

Hind dorsal margin of 9 straight.

Eyes more prominent at the fore corner; labium at rest extending backward to the second legs; a lateral spine on 4, 5 or 6-9. Male projection conical. Female valves reaching apex of 9. *ÆSCHNA.*

Eyes more prominent in the middle; labium at rest extending backwards beyond second legs; a lateral spine on 7-9; middle appendage notched at tip, laterals half as long. Male projection cut at tip. Female valves shorter than 9. *ANAX.*

Family Libellulide.—Antennæ 7-jointed; tarsi 3-jointed; labium spoon-shaped, covering labrum and frons when closed. Some Libelluline nymphs closely resemble those of the Cordulegasterinæ (*q. v.*), but may be distinguished by the teeth on the opposed margin of the lateral labial lobes being so short as to form an almost straight line of union when closed. Characters for separating Corduline from Libelluline nymphs are as yet unknown, as the latter subfamily has not been monographed.

Subfamily Cordulinæ:

An erect pyramidal horn on the front of the head.

No dorsal hook on 10; lateral spine on 9 reaching as far as level of tips of appendages. DIDYMOPS.

At least a small dorsal hook on 10; lateral spines on 9 much shorter than in *Didymops*. MACROMIA.

No erect pyramidal horn on the front of the head.

A tubercle on either side of the top of the head; 10 very short, a dorsal hook on 3-9, a sharp lateral spine on 8-9, those of 9 exceeding the appendages. EPICORDULIA.

No such tubercles.

Lateral spines of 8 very short, of 9 long, sharp, divergent, much longer than the appendages.

TETRAGONEURIA (group of *cynosura*).

Lateral spines of 8-9 flat, sharp, incurved; of 9 not longer than the appendages. SOMATOCHLOA (group of *libera*).

Subfamily Libellulinæ:

Middle (dorsal) terminal appendage a little longer than the inferiors (ventrals), all spinous. Teeth on opposed margin of lateral labial lobes flat, not interlocking, 8 and 9 with a long, sharp, incurved lateral spine. PANTALA.

Middle (dorsal) terminal appendages shorter than the inferiors, laterals without spines. Teeth on opposed margin of labial lobes much shorter than in *Pantala*, interlocking in a nearly straight line; otherwise as in *Pantala*. TRAMEA.

In the Canadian Entomologist, July, 1897, pp. 167-168, Professor Needham gives a table for the genera of Gomphine nymphs.

KEY TO THE GENERA OF DRAGONFLIES (*imagoes*) KNOWN OR PRESUMED TO OCCUR IN INDIANA.

Wings similar in size and shape, folded in repose (in *Lestes* usually held half-opened); eyes far apart; males with two superior and two inferior abdominal appendages. Nymphs with three caudal tracheal-gills.

Suborder Zygoptera, p. 247

Wings dissimilar, hind wings usually wider, horizontally expanded in repose; eyes touching or not so widely separated as in the *Zygoptera*; males with two superior and one inferior abdominal appendage. Nymphs without caudal tracheal-gills.

Suborder Anisoptera, p. 247

Zygoptera. Family Agrionidae.

More than two antecubitals.

Subfamily Calopteryginae. 1.

Two antecubitals.

Subfamily Agrioninae. 2.

1. Basilar space free; males without pterostigma, females with or without.

Calopteryx, p. 251

Basilar space cross-veined; males with the base of the wings bright colored.

Heterina, p. 253

2. Median and subnodal sectors arising from the principal sector much nearer the arculus than the nodus.

Lestes, p. 255

Median and subnodal sectors arising near the nodus. 3.

3. Bristles of the tibiae twice as long as the spaces between them.

Argia, p. 260

Bristles of the tibiae shorter, never twice as long as the spaces between them. 4.

4. No apical spine on the sternum of 8 in the female. Pterostigma similar on front and hind wings in both sexes. 5.

An apical spine on the sternum of 8 in the female. 6.

5. No postocular spots or narrow occipital line; size larger, length of abdomen about 28.

Erythroma, p. 264

Postocular spots or narrow occipital line present; size smaller, abdomen about 20 (16-23).

Nehalennia, p. 265

6. No postocular spots; colors red and dull black; pterostigma similar on front and hind wings.

Amphiagrion, p. 267

Postocular spots present. 7.

7. Pterostigma of front and hind wings similar; nodal sector arising near fifth postcubital on front wings, and near the fourth on hind wings.

Enallagma, p. 267

Pterostigma of front and hind wings dissimilar in coloration in the male; nodal sector arising near fourth postcubital on front wings and near the third on hind wings. 8.

8. Pterostigma of front wings of male normal in position, darker than of hind wings.

Ischnura, p. 277

Pterostigma of front wings of male removed from the costa, lighter than of hind wings.

Anomalagrion, p. 280

Anisoptera.

Antecubitals of the first and second series not corresponding (excepting the first one and one other); triangles of front and hind wings generally of similar shape.

Family Aeschnidae, p. 248

Antecubitals of the first and second series mostly corresponding; triangle of front wings with its long axis at right angles to the wing, of hind wings with its long axis coinciding with that of the wing.

Family Libellulidæ, p. 249

Family Aeschnidæ.

Eyes separated or meeting at a single point dorsally; females without genital valves (excepting in the Petaluroid Gomphinæ). 1.

Eyes meeting dorsally for some distance; females with genital valves.

Subfamily Aeschninæ. 7.

1. Eyes separated by at least the width of the pterostigma, usually more. *Subfamily Gomphinæ*. 2.

Eyes meeting at a single point dorsally, or just separated. *Subfamily Cordulegasterinæ*, represented by a single genus in Indiana. *Cordulegaster*, p. 299

2. Median lobe of labium bifid; pterostigma narrow, not less than 8 long. *Tachopteryx*, p. 281

Median lobe of labium entire; pterostigma not so long. 3.

3. Triangles usually with cross-veins. 4.
Triangles and supratrangular spaces free. 5.

4. Legs long, apex of last femora reaching to the base of 3.

Hagenius, p. 282

Legs short, apex of last femora reaching only to base of 1.

Progomphus, p. 283

5. Inferior appendage of male bifid, the two branches divergent; dark markings of the thorax distinct, often confluent. 6.

Inferior appendage of male bifid; the branches contiguous; thorax bright green with faint darker markings.

Ophiogomphus, p. 298

6. Last femora long, the apex reaching the base of 3, with numerous small spines, and among them several conspicuously larger ones. *Dromogomphus*, p. 296

Last femora shorter, with numerous short spines only.

Gomphus, p. 283

7. Upper and lower sectors of the arculus arising about equally distant from the median and submedian veins respectively; thorax not uniform green. 8.

Upper sector of arculus arising much nearer the median vein than does the lower sector to the submedian; thorax uniform green. *Anax*, p. 305

8. Subnodal sector not furcate. 9.

Subnodal sector furcate. 11.

9. Triangle more than once crossed. 10.

Triangle once crossed, basilar and supratrangular spaces free.

Gomphaeschna, p. 301

10. Wings broad, basilar and supratrangular spaces cross-veined.

Boyeria, p. 300

Wings narrow, basilar space free, supratrangular cross-veined.

Basiaeschna, p. 301

11. Supplementary sector between subnodal and median sectors separated from the subnodal by one or two cells; hind wing 55 or more in length. *Epicarchna*, p. 302
 Supplementary sector between subnodal and median sectors separated from the subnodal by three to seven cells; hind wing 50 or less in length. *Archna*, p. 303

Family Libellulidæ.

Eyes tubercled behind; males with auricles on 2, and anal margin of hind wings excavated. *Subfamily Cordulinae.* 1.

Eyes not tubercled; males without auricles on 2, and anal margin of hind wings not excavated. *Subfamily Libellulinae.* 6.

1. Supratrangular space crossed, sectors of the arculus more or less united at their origin. 2.
 Supratrangular space free, sectors of the arculus separate at their origin. 3.

2. Eyes touching at hardly more than a point; triangles free; occiput larger than vertex; hind wing less than 40 in length.

Didymops, p. 307

Eyes touching for a short distance; occiput much smaller than vertex; hind wing 40 or more. *Macromia*, p. 307

3. Wings with some dark markings, at least at the base of the hind wings. 4.

Wings without dark markings; triangle of front wings free or crossed, of hind wings crossed, rarely free; hind wings with or without an internal triangle; colors metallic.

Somatochlora, p. 312

4. Triangle of hind wings usually free, of front wings crossed; hind wings without internal triangle; black markings on hind wings only, or small at base of front wings.

Tetragoneuria, p. 310

Triangle of hind wings crossed; dark markings on both wings. 5.

5. Wings with dark at base and apex and usually at nodus; hind wings without internal triangle. *Epicordulia*, p. 310

Wings with dark spots at base and along the front margin.

Neurocordulia, p. 312

6. Hind wings very wide at base; the triangle of the front wings placed as far beyond the level of the triangle of the hind wings as the latter triangle is long. 7.

Not as above; triangle of front wings on a level with the triangle of the hind wings or only a little beyond it. 8.

7. Segments 3 and 4 with two, and 5 with one additional transverse carina; base of hind wing transparent, the anal margin yellowish or the anal angle with a fuscous spot.

Pantala, p. 314

Segments 3 and 4 with one additional transverse carina; base of hind wings broadly colored for its entire width.

Tramea, p. 315

8. Hind lobe of prothorax large, bilobed; supratrangular veins normally absent in front wings; antecubitals of front wings 10 or less in number, or, in *Mesothemis* (which has two rows of 5 to 7 strong spines on the last tibiæ) 11 or 12. 9.
- Hind lobe of prothorax narrower than the other lobes, its hind margin entire; supratrangular veins usually present in front wings, when absent more than 13 or less than 8 antecubitals in front wings; antecubitals in front wings more than 10 in number, excepting in *Nannothemis* (which has the triangle of the front wings four-sided), where there are 6 or 7. 14.
9. Size small; abdomen robust; wings uniform yellow (male) or marked with fuscous (female); hind wing not more than 20 in length; triangle of front wing free; sectors of arculus distinct at their origin; sectors of the triangle of the hind wings arising from its hind angle; an additional carina on 4; hamule of male not bifid. *Perithemis*, p. 317
- Size larger; body slenderer; triangle of front wings crossed; hamule of male bifid. 10.
10. Wings with dark markings beyond the nodus; pterostigma at least four times as long as wide; sectors of the arculus separate at their origin or connected for only a short distance; sectors of the triangle of the hind wings arising from its hind angle. *Celithemis* p. 318
- Wings without dark markings beyond the nodus. 11.
11. Wings black at extreme base; pterostigma not more than twice as long as wide; sectors of arculus usually distinctly stalked; sectors of the triangle in the hind wings arising from its hind angle. *Leucorhinia*, p. 320
- Wings not black at the extreme base, or if so (*Pachydiplax*) the pterostigma at least three times as long as wide. 12.
12. General color of the body red or yellow; wings hyaline or with fuscous or pale yellow restricted to the extreme base or extending to the nodus; pterostigma variable; sectors of the arculus usually distinctly stalked; sectors of the triangle of the hind wings usually arising from its hind angle. *Sympetrum*, p. 321
- Colors of the body blue, green and brown. 13.
13. At least 10 antecubitals in the front wings, the last one not continuous; sectors of the arculus stalked; in the hind wings the lower sector of the triangle arises from its hind angle, the upper one from its outer side; last tibiæ with two rows of 5-7 strong spines. *Mesothemis*, p. 325
- Normally 6 antecubitals in the front wings, the last one continuous; sectors of arculus stalked; in the hind wing the lower sector of the triangle arises from its hind angle, the upper usually from its outer side; last tibiæ with two rows of 10 or more smaller spines. *Pachydiplax*, p. 326

14. Small, hind wing not more than 17 in length; triangle of front wings with the anterior side angulated forming a trapezium; less than 8 antecubitals. *Nannothemis*, p. 327
Larger, triangle of ordinary form, not as above; more than 10 antecubitals in the front wings. 15.
15. Male without ventral hooks on 1; female with third tibiæ at least a little longer than third femora. *Libellula*, p. 327
Male with a pair of ventral hooks on 1; female with third tibiæ as long as third femora. *Plathemis*, p. 333

CALOPTERYX Leach (*calos* Gr., beautiful; *pteryx* Gr., wing).

(*Calepteryx*) Leach, Edinb. Encycl. IX, p. 137, 1815.

A genus of about 18 species, found in North America, Europe, Asia, Japan and Northern Africa. The body color is beautifully metallic. The pterostigma is wanting in the males; present or not in the females.

Wings spatulate, the hind margin strongly rounded. 1.

Wings narrow, front and hind margins, nearly parallel. 2.

1. Wings uniformly black or brown. *maculata*.

Wings hyaline at base, apical third or fourth dark. *aquabilis*.

2. Wings of male apically dark; abdomen less than 40. *dimidiata* and *apicalis*.

Wings hyaline; abdomen more than 40. *angustipennis*.

C. MACULATA Beauvois (*maculatus* L., spotted).

Agrion maculata Beauvois, Ins. Afr. Amer., p. 85, 1805.

C. maculata Hagen, Syn. Neur. N. A., p. 57, 1861; Psyche V, p. 249, 1889.

A. maculata Kirby, Synonymic Cat., 1890.

Ab. male and female 38; h. w. male 28, female 31.

Male.—Metallic blue or green; under parts of head, thorax and abdominal segments 1-7 or 8 black; a humeral stripe, thoracic sutures and legs, black; venter of 8-10 usually whitish. Wings velvety black in the adult, paler and duller in immature individuals. Superior abdominal appendages forcipate, apical half widened, outer margin denticulated; inferiors one-fourth shorter.

Female.—Similar; duller; abdomen brassy brown; 8-10 with a pale mid-dorsal longitudinal line. Wings colored as in immature males, frequently darker apically and basally; pterostigma white, variable in size, reticulated.

Eastern United States; Quebec to Florida, west to Kansas and Texas; California, Iowa, Michigan, Ohio, Illinois, Indiana.

Turkey Lake (Kellicott); Elkhart, May 25, 1894; June 4-19, 1895 (Weith); Eagle Lake, July 6, 1898 (Deam); Crawford County, May

12, July 8 and 11, 1899 (Blatchley and Deam); Shriner Lake and Eel River, Whitley County, June 22 and 24, 1898, not common.

This species flies in Indiana from late spring till early fall. It prefers the smaller streams, seeking the cool, shady places where the vegetation is rankest. Rarely they are found in large numbers in woodland, even at a considerable distance from any stream. Their fluttering flight is very suggestive of the skippers among the butterflies. The metallic coloration and black wings make this very common species conspicuous.

C. *ÆQUABILIS* Say (*æquabilis* L., uniform).

C. æquabilis Say, Journ. Ac. Phila. VIII, p. 33, 1839; Hagen, Psyche V, p. 246, 1889.

Agrion æquabilis Kirby, Synonymic Cat., 1890.

Ab. male and female 40; h. w. male 32, female 33.

Male.—Metallic blue or green; head dark. Mid-dorsal thoracic carina, humeral line, more or less on thoracic sutures and legs and appendages, black. Wings yellowish hyaline, the anterior with the apical third or fourth and the posterior with the apical half or third dark. Appendages similar to *maculata*, but offering several differences.

Female.—Similar; brassy green, abdomen becoming brownish at tip, a light longitudinal median dorsal line on 8–10, and on the sides of 5–10; sides of thorax with some yellow. Wings apically lighter; pterostigma white, narrow and not reticulated.

Canada; Maine, Massachusetts, New York, Vermont, Ohio, Illinois (Adams).

Habits described as similar to *C. maculata*; taken in midsummer.

C. *DIMIDIATA* Burmeister (*dimidiatus* L., divided in the middle).

C. dimidiata Burmeister, Handb. Ent. II, p. 829, 1839; Hagen, Syn. Neur. N. A., p. 57, 1861; Psyche V, p. 246, 1889.

Agrion dimidiata Kirby, Synonymic Cat., 1890.

Ab. male 38, female 35; h. w. male 31, female 32.

Male.—Metallic green or blue; under part of head, thorax and abdomen, black; mid-dorsal thoracic carina, sutures, abdominal appendages and legs, black. Rear of head with a sharp tubercle on each side. Wings hyaline, with yellowish tinge, apically black. Appendages of usual shape, similar to *maculata*.

Female.—Similar; wings hyaline, yellowish, apex of hind wings brown, of front wings brownish, less defined; pterostigma white, large, reticulated.

Kentucky, Georgia, Florida,

C. DIMIDIATA APICALIS Burmeister (*apex* L., the extreme end).

C. apicalis Burmeister, Handb. Ent. II, p. 827, 1837; Hagen, Syn. Neur. N. A., p. 56, 1861.

C. dimidiata race *apicalis*, Hagen, Psyche V., p. 246, 1889.
Agrion apicalis Kirby, Synonymic Cat., 1890.

Ab. male 36, female 32; h. w. male 27, female 29.

Male.—Metallic blue or green; under part of head and abdomen, thoracic sutures, feet and abdominal appendages, black; thorax below yellowish. Rear of head with a sharp tubercle on each side. Wings hyaline, the apical sixth black. Appendages of usual form.

Female.—Similar; wings hyaline without pterostigma, or with a small white one of 1–3 cells.

Pennsylvania, Delaware, Massachusetts, New York, Michigan.

C. ANGUSTIPENNIS Selys (*angustus* L., narrow; *penna* L., a wing).

Sylphis angustipennis Selys. (male), Syn. Cal., p. 9, 1853.

S. elegans Selys (female), Syn. Cal., p. 9, 1853.

C. angustipennis Hagen, Syn. Neur. N. A., p. 56, 1861; Psyche V, p. 242, 1889.

Agrion elegans Kirby, Synonymic Cat., 1890.

Ab. male 46, female 43; h. w. male 36, female 38.

Male.—Brassy green, in old specimens the thorax becoming coppery; under part of head, thorax and abdomen, excepting 1, which is white, dark; thoracic sutures, feet and abdominal appendages, black. Rear of head with a tubercle on each side. Wings hyaline, larger veins, excepting the sub-costa, conspicuously green.

Female.—Similar; pectus dull yellowish; abdomen, towards its tip duller, a light, mid-dorsal longitudinal stripe on 8–10. Wings hyaline, tinged with yellowish, more apparent toward the base; pterostigma wanting.

Kentucky, Georgia, Ohio, Pennsylvania.

Early and midsummer; in western Pennsylvania common on June 18, rare, disappearing on July 2. In habits this species seems very similar to *Heterina americana*. It frequents the rapid ripples of the larger streams, spending much of the time on the wing over water. Its flight is more rapid than *maculata*, and it is captured with more difficulty.

HETÆRINA Hagen (*hetairos* Gr., a companion).

Hagen, Syn. Cal., p. 30, 1853.

A genus of about 40 species, confined to the western hemisphere. Two species occur in Indiana. They may be separated by the following characters:

Male.—Base of hind wings red; tip of wings hyaline. Female, wings flavescent at base. *americana*.

Male.—Base of hind wings brown; tip of wings dark. Female, wings flavescent throughout. *tricolor*.

H. AMERICANA Fabricius.

Agrion americana Fabricius, Ent. Syst. Supp., p. 287, 1798.

H. americana Hagen, Syn. Neur. N. A., p. 60, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 36, female 31; h. w. male 28, female 30.

Male.—Head and thorax coppery red (adult), or metallic green (immature); humeral, two lateral lines and pectus, white or yellowish. Abdomen metallic green above, becoming dull with age, an indistinct median stripe; 3-7 with yellow basal rings; yellow on sides, excepting 9; beneath black, excepting at base and apex. Wings hyaline, basal fourth bright red, in the front wings reaching the anterior margin only at the extreme base; the red brighter in the front wings, shaded with brown in hind wings; pterostigma small, brown. In immature specimens the red is paler and duller and the pterostigma is yellow. Legs dark and pale. Superior appendages forcipate, outer margin denticulate at the middle, inner surface with two tubercles near the middle, apex obtuse; lower appendages reaching to the first tubercle of the superiors, truncate.

Female.—Head, thorax and abdomen metallic green, the last becoming dull with age; humeral and lateral lines wider than in the male, not so noticeably bordered with black. Wings hyaline, basally and along the costa yellowish; pterostigma white.

Maine to Maryland, west to Wisconsin and Missouri; Iowa, Michigan, Illinois, Ohio, Indiana.

“*Lestes basalis*.—Inhabits Missouri, Indiana and Massachusetts” (Say); Turkey Lake (Kellicott); Christiana Creek, July 8, 1895, common (Weith); Lake County, June 23, 1899; Montgomery County, May 26, 1899 (Blatchley); Shriner and Round Lakes, August 1, 1896, September 2, 1897, rare; Wabash River, Wells County, August 20, 1896, June 22, 1898, abundant.

This common species flies as late as the middle of October. It is rarely taken far from its preferred environment—the banks of larger streams, especially near shallow rocky ripples grown up with water-willow (*Dianthera*), where it may often be found in great numbers. “Another notable habit is that of congregating, sometimes in companies of hundreds. These assemblies commence in the afternoon and do not disperse until the warmth of the following day awakens them to activity. Both sexes take part in these assemblies, and they rest so compactly that a single sweep of the net may capture scores of them.”—Kellicott. The bright red at

the base of all the wings of adult males distinguish them at once as they flit from some boulder in mid-stream to the swaying stem of a water-willow.

Heterina scelerata Walsh, described from Illinois, is a "pterostigmatous variation of *americana* Fabr."—Calvert, *The Odonata of Baja California*, p. 474.

H. TRICOLOR Burmeister (*tri* L., three; *color* L.).

Calopteryx tricolor Burmeister, Handb. Ent. II, p. 827, 1839.

H. tricolor Hagen, Syn. Neur. N. A., p. 61, 1861; Kirby, Synonymic Cat, 1890.

Ab. male 41, female 36; h. w. male and female 30.

Male.—Blackish brown; humeral, two lateral stripes, and pectus yellow. Abdomen of almost uniform coloration; narrow interrupted basal rings on 2-6. Wings hyaline, tipped with brown; the front ones basally red, the red not reaching the costa, and the hind ones basally brown, the brown produced along the costa and not reaching the hind margin; pterostigma very small, black. Legs dark throughout. Superior appendages slenderer than in *americana*, inner surface with a tubercle and a median dilation; inferiors half as long as superiors.

Female.—Bronze-green and buff; throax green, mid-dorsal carina black, buff on either side uniting with the humeral line; sides buff and green. Abdomen green and pale. Wings flavescent throughout, pterostigma white. Legs pale and green.

Pennsylvania, Illinois, Georgia, Texas, Ohio, Indiana.

Wabash River, Wells County, August 20, 1898, a single male.

This species frequents the willow-covered banks of larger streams, especially about rapids. It is taken with more difficulty than *H. americana*.

LESTES Leach (*lestes* Gr., a plunderer).

Leach, Edinb. Encycl. IX, p. 137, 1815.

A genus of about 60 species, distributed over most of the world—America, the West Indies, Europe, Africa, Madagascar, Asia, Japan, Malay Archipelago, Australia, New Guinea, New Zealand, and the Sandwich Islands. Five fossil species have been referred to this genus. Nine species will doubtless be found in Indiana, though only seven have been recorded as yet. Their usual haunts are ponds, marshes and lakes, where they flit from stem to stem among the low herbage, usually resting with the wings half expanded. Some species are frequently met with in woodland.

Male inferior abdominal appendages less than half as long as the superiors. *eurinus* and *congener*.

Male inferior abdominal appendages more than half as long as the superiors. 1.

1. Male with inferior appendages shorter than the superiors; rear of head in both sexes blackish. 2.

Male with inferior appendages longer than the superiors, incurved; rear of head in both sexes yellow. *inequalis*.

2. Male inferior appendages sigmoid; female with a yellow band across the rear of head. *unguiculatus*.

Otherwise, male inferior appendages nearly straight, dilated or not at the apex. 3.

3. Thorax metallic green; mid-dorsal thoracic carina and humeral stripe, if yellow, very narrowly so. 4.

Thorax not metallic green, brownish. 5.

4. Abdomen less than 34 in length. *uncatus*.

Abdomen more than 34 in length. *vigilax*.

5. Abdomen of male pale, very long, about 40, and slender. *rectangularis*.

Abdomen of male shorter, of brighter coloration than the thorax. *disjunctus* and *forcipatus*.

L. EURINUS Say (*eurinus* Gr, with a good nose, keen scented).

L. eurina Say, Journ. Ac. Phila. VIII, p. 36, 1839; Hagen, Syn. Neur. N. A., p. 70, 1861; Scudder, Psyche VI, p. 66, 1891.

L. eurinus Kirby, Synonymic Cat., 1890.

Ab. male 38, female 34; h. w. male 27, female 28.

Male.—Dark metallic green; lips pale. Mid-dorsal carina and humeral suture black, second lateral suture more or less so. Abdomen with narrow yellowish basal rings on 2-7. Wings yellowish. Legs dark and pale. Superior appendages with an acute basal tooth and a truncate, denticulated median one on the inner side; inferior appendages one-third as long.

Female.—Similar; mid-dorsal thoracic carina yellow.

Illinois, New York, Maine, Massachusetts.

This species and the following are the two of the nine species regional for Indiana, that have not yet been recorded. They are distinguished from the others by the short inferior appendages of the male. *Eurinus* has been taken in New York during July.

L. CONGENER Hagen (*congener* L., of like race).

L. congener Hagen, Syn. Neur. N. A., p. 67, 1861; Selys, Bull. Ac. Belg. (2) XIII, p. 316, 1862; Kirby, Synonymic Cat., 1890.

Ab. male 29, female 27; h. w. male 20, female 21.

Male.—Blackish brown; lips, mid-dorsal carina, narrow humeral stripe, sides of thorax, and head and thorax below, pale yellow; second lateral suture black. Abdomen with yellowish interrupted rings on 2-7; a trace of a white longitudinal mid-dorsal line. Rear of head, pectus and segments 9-10 primrose in mature males. Legs black and pale yellow. Superior appendages black, lighter at base, longer than 10, on the inner surface is an acute basal tooth, followed by a median denticulate dilation; inferiors reaching to the middle of this dilation, curved inwards and upwards.

Female.—Similar; humeral stripe wider, and the pale, longitudinal dorsal line of the abdomen more evident.

New York, Delaware, Missouri, Colorado, Nevada, Yellowstone, Ohio. *Congener* has been taken in Ohio in the fall, flying well into October.

L. UNGUICULATUS Hagen (*unguiculus* L., a finger-nail). Pl. VII, fig. 1.

L. unguiculata Hagen, Syn. Neur. N. A., p. 70, 1861.

L. unguiculatus Kirby, Synonymic Cat., 1890.

Ab. male 28, female 27, h. w. male 19, female 21.

Male.—Blackish brown; mid dorsal carina, humeral suture, and face and under parts of head and thorax, yellow. Abdomen above metallic green or brown; narrow interrupted basal rings on 2-7, passing into the yellow on the sides of 1-7. Mature specimens of both sexes more or less pruinose. Pterostigma brown, whitish at either end. Legs black and pale.

Female.—Similar; humeral stripe wider; rear of the head with a yellow band from eye to eye, obscure in older individuals.

Quebec, Nova Scotia; New Jersey, Massachusetts, Missouri, Maine, New York, Illinois, Pennsylvania, California, Iowa, Wyoming, Michigan, Ohio, Indiana.

Boat Lake, July 4, 1897, common; Simonton Lake, July 13, 1899 (Weith); Chapman Lake, July 6, 1898; Eagle Lake, July 9, 10 and 12, 1898 (Deam); Shriner and Round lakes, September 2, 1897, July 21, 1898; Wabash River, Wells County, July 3, 1898.

A common species flying from June till October.

L. UNCATUS Kirby (*uncus* L., a barb). Pl. VII, fig. 2.

L. uncatus Kirby, Synonymic Cat., p. 160, 1890.

L. forcipata Hagen, Syn. Neur. N. A., p. 71, 1861.

L. hamata Selys, Bull. Ac. Belg. (2) XIII, p. 300, 1862.

Ab. male 29, female 26; h. w. male 21, female 23.

Male.—Metallic green; face, under side of head and thorax, sides below and a much reduced humeral line (often wanting), yellowish. Abdomen above metallic green, last two or three segments black; 3-7

with narrow yellow basal rings; sides of 1-7 yellow. Pterostigma with a white vein at either end. Legs black lined with pale.

Female.—Similar; mid-dorsal thoracic carina yellow; humeral stripe narrow; basal rings of segments 3-7 interrupted; basal half of 1 yellow.

Canada, Nova Scotia; District of Columbia, Illinois, Missouri, New York, Maine, Massachusetts, New Hampshire, Georgia, Wisconsin, South Dakota, California, Wyoming, Michigan, Ohio, Indiana.

Wabash River, Wells County, June 19, 1898, June 11, 1899; Frantz Fishpond, June 5, 1899 (Deam *et al.*).

A beautiful and common species, flying until late in the summer, and often taken at a considerable distance from water.

L. DISJUNCTUS Selys (*disjunctus* L., disconnected).

L. disjuncta Selys, Bull. Ac. Belg. (2) XIII, p. 302, 1862.

L. disjunctus Kirby, Synonymic Cat., 1890.

Ab. male 29, female 27; h. w. male 19, female 21.

Male.—Blackish brown; face, under part of head and thorax, sides of throax below, humeral stripe, and usually mid-dorsal carina, yellow; second lateral suture with more or less black. Abdomen metallic green or bronze, last three segments duller; 3-7 with pale interrupted narrow basal rings; sides of 1-7 yellow. Both sexes with head, thorax, and base and apex of abdomen more or less primrose in older individuals. Legs dark lined with pale.

Female.—Similar; humeral stripe wider than in the male, as in both sexes wider below.

Nova Scotia; District of Columbia, Maine, Illinois, New Hampshire, New York, Colorado, Wyoming, Yellowstone, Michigan, Ohio, Indiana.

Simonton Lake, apparently rare, July 11, 1899; Elkhart, July 17, 1899 (Weith).

This species may be looked for during July and August.

L. FORCIPATUS Rambur (*forceps* L., a pair of pincers). Pl. VII, fig. 3.

L. forcipata Rambur, Ins. Nevr., p. 246, 1842.

L. hamata Hagen, Syn. Neur. N. A., p. 70, 1861.

L. forcipatus Kirby, Synonymic Cat., 1890.

Ab. male 33, female 31; h. w. male 22, female 24.

Male and female.—Very similar to *disjunctus*; larger, humeral stripes wider, equal in both sexes (in *disjunctus* wider in the female than in the male); sides of thorax (metepisternum and metepimeron) usually with less black; pterostigma black (brown in *disjunctus*). The superior appendages of the male differ as follows: in *disjunctus* the basal tooth is about equal to the apical one, in *forcipatus* it is larger; the apical tooth

is noticeably more acute in *disjunctus* than in *forcipatus*. The inferior appendages are apically more widened in *forcipatus* than in *disjunctus*.

New Jersey, Georgia, Illinois, Massachusetts, Florida, Wisconsin, Texas, Colorado, Pennsylvania, New York, Iowa, Ohio, Indiana.

Wabash River, Wells County, May 25, 1899, three males (Deam).

The first of its genus on the wing in Indiana in the spring. It has been taken in Ohio and western Pennsylvania as early as April; flies until August.

L. RECTANGULARIS Say (*rectus* L., straight; *angulus* L., an angle).

Pl. VIII, fig. 5.

L. rectangularis Say, Journ. Ac. Phila. VIII, p. 34, 1839; Hagen, Syn. Neur., p. 66, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 40, female 32; h. w. male 21, female 23.

Male.—Blackish brown; face, under part of head and thorax, sides of thorax below, humeral stripe (wider below) and mid-dorsal carina, yellow or greenish. Abdomen pale brown basally, becoming black posteriorly; pale segments have their apices dark; 1-7 with pale narrow basal rings. Legs pale, lined with dark.

Female.—Similar; abdomen sometimes greenish bronze; always darker than in the male, the sides yellowish. Legs darker.

Massachusetts, Maryland, New York, District of Columbia, Illinois, Indiana, Georgia, Maine, Pennsylvania, Minnesota, Michigan, Ohio.

"Inhabits Indiana and Massachusetts" (Say); Elkhart, June 15, in grove, June 23, in woods, June 25, 1897, in marsh, nowhere common; Boot Lake, July 4, 1897; Simonton Lake, July 11, 1899; Elkhart, city limits, July 14, 19 and 30, 1899, common (Weith); Eagle Lake, July 6 and 12, 1898 (Deam); Wabash River, Wells County, June 22, 1898, June 11 and September 10, 1899 (Deam *et al.*); Lake, Jackson Township, Wells County, May 29, 1899 (Deam); Round and Shriner lakes, September 2, 1897, June 8, 1898; woodland, near Wabash River, Adams County, June 19, 1898, very abundant.

June to September. This species is often taken in deep woodland, usually near some swampy area, but often it is found in high woods and at a distance from water. Of the *Lestes* found in the State this species is most often met with. It seems at home anywhere. The long slender abdomen of the male distinguish it at once from other species.

L. VIGILAX Hagen (*vigilax* L., watchful). Pl. VII, fig. 4.

L. vigilax Bull. Ac. Belg. (2) XIII, p. 306, 1862; Kirby, Synonymic Cat., 1890; Kellicott, Journ. Cin. Soc. Nat. Hist., p. 200, 1895.

Ab. male 37, female 35; h. w. male 24, female 26.

Male.—Metallic green; lips, under part of head and thorax, sides of thorax below, narrow humeral stripe and mid-dorsal carina, yellow or greenish. Abdomen metallic green, obscure and black at the tip, the basal segments each with a pale narrow basal ring. Legs dark, lined with pale. Head, thorax and base and apex of abdomen more or less primrose in older individuals.

Female.—Similar; the humeral stripe wider; 9 and 10 pale, largely yellow.

New Jersey, Florida, Massachusetts, Pennsylvania, Michigan, Ohio, Illinois (Adams), Indiana.

Chapman Lake, July 7, 1898; Goose Lake, July 11, 1899 (Deam); Shriner and Round lakes, September 2, 1897, June 7 and July 21, 1898, abundant, pairing in September and July.

This is a species of the lakes, where, among the *Scirpus* and *Typha*, from July to September it may sometimes be found very abundantly. It is a slender, graceful and beautiful species.

L. INEQUALIS Walsh (*in L.*, not; *æqualis* L., equal). Pl. VII, fig. 6.

L. inequalis Walsh, Proc. Ac. Phila., p. 385, 1862; Kirby, Synonymic Cat., 1890.

Ab. male 39, female 37; h. w. male 26, female 27.

Male.—Metallic green; face, under parts of head and thorax and sides of thorax below, yellow or pale; mid-dorsal carina and a humeral line black or very narrowly pale. Abdomen metallic green, coppery or duller at apex, the last segments blackish; sides yellow; pale narrow basal rings on 3-6 or 7. Legs light, lined with dark. Head, prothorax and 9 and 10 more or less primrose in older individuals.

Female.—Similar; the mid-dorsal carina and humeral stripes yellow, wider than in the males.

Maine, Illinois, New Hampshire, New Jersey, Pennsylvania, New York, Michigan, Ohio, Indiana.

Round Lake, July 22, 1898, a pair taken at rest on a spatterdock leaf. In form, color and habits this species much resembles *vigilar*; it is larger and more robust.

ARGIA Rambur (*argia* Gr., idleness).

Rambur. Ins. Névr., p. 254, 1842.

A genus of about 50 species, confined almost entirely to America—one species known from the Kurile Islands, another from the Moluccas and a third from the Cape of Good Hope. Five species have already been taken in the State and a sixth species will probably be found in the southern part along the Ohio. In their choice of environment they differ very decidedly from the *Lestes*, *Enallagmas* and other smaller

agrionines, preferring the glaring sun as it shines on some bare beach or boulder, rather than the rank grasses and sedges of some stream or swale.

Pterostigma surmounting more than one cell, *i. e.*, the pterostigma longer than the cell just behind it. *putrida*.

Pterostigma surmounting only one cell, *i. e.*, not longer than the cell just behind it. 1.

1. Wings entirely dark brown. *fumipennis*.
Wings hyaline or slightly tinged or tipped with brownish. 2.
2. Males with last two segments blue, segments 1-7 of abdomen black, with no blue or violet. *tibialis*.
Males with last three segments blue. 3.
3. Males violet and black, the violet predominating on 1-7. *violacea*.
Males blue and black, the black predominating on 1-7. 4.
4. Males with the thorax deep blue with wide black stripes on the mid-dorsum and the humeral suture. *sedula*.
Males with the thorax light blue, not heavily marked with black. *apicalis*.

Rear of head black, or blackish—*putrida* and *tibialis*.

Rear of head yellowish—*violacea*, *sedula* and *apicalis*.

A. PUTRIDA Hagen (*putridus* L., polluted). Pl. IV, fig. 2; Pl. VII, fig. 7.

Agrion putridum Hagen, Syn. Neur. N. A., p. 96, 1861.

Argia putrida Kirby, Synonymic Cat., 1890.

Ab. male 34, female 32; h. w. male 24, female 25.

Male.—Gray or light brown; vertex, mid-dorsum of the thorax and a stripe on either side, black. Abdomen black, the basal segments sometimes pale above, 3-7 with pale narrow basal rings. Older individuals are largely primrose. Wings with the upper sector of the triangle ending on the margin beyond the origin of the ultranodal and almost on a level with the pterostigma. Legs pale lined with dark. Apex of 10 excised, the sides produced; appendages short.

Female.—Younger specimens are brown, much like the males, with the abdomen mostly brown. Fully matured females have the head and thorax pale blue, with the mid dorsal thoracic carina and very narrow lines on the sutures black. The abdomen is brown above, bounded on either side with an interrupted black stripe; below the black, pale blue or greenish.

Quebec; Maine, New York, Maryland, Virginia, Wisconsin, Illinois, Texas, Pennsylvania, Florida, Michigan, Ohio, Indiana.

Elkhart, July 30, 1899, common (Weith); Crawford County, July, 11, 1899 (Deam); Whitley County, August 1, 1896, September 2, 1897;

St. Mary's River, Ft. Wayne, June 26, 1898, abundant; Eel River, Allen County, June 23, 1898; Wabash River, Wells County, July and August, 1896, June 10 and 22, and July 3, 1898.

An abundant species to be found during most of the Odonatological season. *Putrida*, *tibialis* and *apicalis* are much alike in habits, frequenting sunny exposed localities, where they rest on the ground, on boards, or on rocks or boulders. *Violacea* and *sedula* prefer the sedge and rush-margined banks of some stream or lake, where they live much after the manner of the *Enallagmas* and many others of the *Agrioninae*. The *Argias* are hardy species and are apparently holding their own along the Wabash River, where the delicate *Enallagmas* and *Nehalennias* seem to be disappearing as a result of the pollution of the stream. On June 22, 1898, they comprised the great bulk of the Odonate fauna along the banks of this river in Wells County. *Putrida* was most abundant, and many pairs were observed ovipositing. In one case several pairs were observed on the same support—a small board fastened in the mud at the bottom of the river, one end above the surface of the water—and in the filth-laden algæ which covered this board the females were ovipositing their eggs. In some cases both male and female were submerged. Occasionally as the female descends into the water, the male will struggle, apparently trying to free himself, but, unable to do this, he straightens his abdomen, avoiding the water as long as he may, and so is gradually drawn beneath the surface.

A. FUMIPENNIS Burmeister (*fumus* L., smoke; *penna* L., a wing).

Agrion fumipenne Burmeister, Handb. Ent. II, p. 819, 1839;
Hagen, Syn. Neur. N. A., p. 97, 1861.

Argia fumipennis Kirby, Synonymic Cat., 1890.

Ab. male 26, female 28; h. w. male 19, female 21.

This species may be known from the other *Argias* by its darkly colored wings. It has been recorded from Florida, Georgia and Kentucky.

A. VIOLACEA Hagen (*violaceus* L., violet colored).

Agrion violaceum Hagen, Syn. Neur. N. A., p. 90, 1861.

Argia violacea Kirby, Synonymic Cat., 1890.

Ab. male 26, female 25; h. w. male 20, female 21.

Male.—Violet; thorax with mid-dorsal stripe, humeral stripe and narrow lines on the lateral sutures black. Abdomen violet, with the following black: interrupted apical rings on 2-4, apical rings on 5 and 6, all of 7 excepting a basal ring; 8-10 blue. Legs pale, lined with dark. Superior abdominal appendages are short and obtuse; the inferiors are longer than the superiors and are bifid.

Female — Brown or dull violet, with mid-dorsal and humeral stripes. Abdomen as in *A. putrida*.

District of Columbia, New York, Maine, Maryland, Virginia, Illinois, Texas, Pennsylvania, Michigan, Ohio, Indiana.

Elkhart, edge of pond, June 11 and 17, 1895; Christiana Creek, July 8, 1895; Indiana Lake, June 25, 1899, common (Weith); Goose Lake, July 11, 1898; Eagle Lake, July 6 and 8, 1898; Marion County, June 22, 1899 (Deam); Round and Shriner lakes, August 1, 1896, September 2, 1897, June 7 and 24, and July 21, 1898, observed pairing on all dates excepting June 7, when only teneral were observed; Eel River, Whitley County, June 23, 1898; Wabash River, Wells County, June 22, 1898.

A common species, on the wing in Indiana from June till September. The violet color of the males distinguish them at once from all other species with which they associate.

A. *SEDULA* Hagen (*sedulus* L., persistent).

Agrion sedulum Hagen, Syn. Neur. N. A., p. 94, 1861.

Argia sedula Kirby, Synonymic Cat., 1890; Kellicott, Journ. Cin. Soc. Nat. Hist., p. 203, Jan., 1895.

Ab. male 26, female 25; h. w. male 18, female 20.

Male.—Deep blue; vertex, mid-dorsal thoracic and humeral stripes and line on second suture, black. Abdomen black, blue as follows: 1, base and sides of 2, basal rings on 3–7, all of 8–10. The basal rings on 3–7 are wider and more conspicuous than in any other species. Feet pale and dark. The superior abdominal appendages are short and rounded; inferiors are bifid, the lower lobe larger than the upper.

Female.—Obscure brownish; mid-dorsal thoracic carina and humeral suture black. Wings slightly flavescent.

Virginia, Texas, Ohio, Indiana.

Elkhart, July 8, 1895, city limits, July 30, 1899, common (Weith); Wabash River, Wells County, July, 1896, rare.

Sedula flies as late as September. With *violacea* this species prefers a life among the rank vegetation along ditches, streams and lakes.

A. *TIBIALIS* Rambur (*tibia* L., the leg). Pl. VII, fig. 8.

Platynemis tibialis Rambur, Ins. Névr., p. 241, 1842.

Agrion fontium Hagen, Syn. Neur. N. A., p. 91, 1861.

Agia tibialis Kirby, Synonymic Cat., 1890.

Ab. male and female 27; b. w. male 21, female 22.

Male.—Dark lilac or blue; vertex, wide mid-dorsal and humeral stripes and line on second suture, black; sides of thorax pale, yellowish. Abdo-

men black, pale narrow basal rings on 2-7; 9 and 10 blue. Legs dark with but little pale.

Female.—Similar to the male; 9 black, 10 yellow.

Virginia, Georgia, Florida, Illinois, New Jersey, Pennsylvania, Texas, Michigan, Ohio, Indiana.

Crawford County, July 11, 1899 (Deam); Wabash River, Wells County, June 22, 1898, common.

June and July. On June 22 this species was associated with *putrida* and *apicalis* along the Wabash River near Bluffton. The habits of the three were very similar, though, perhaps, *tibialis* frequented the vegetation more than the other two. Its dark color distinguishes it in the field.

A. **APICALIS** Say (*apex* L., the extreme end). Pl. VII, fig. 9.

Agrion apicalis Say, Journ. Ac. Phila., VIII, p. 40, 1839.

A. apicale Hagen, Syn. Neur. N. A., p. 91, 1861.

Argia apicalis Kirby, Synonymic Cat. 1890.

Ab. male 29, female 28; h. w. male 21, female 23.

Male.—Pale blue or drab; vertex, mid-dorsal thoracic carina and a spot on the humeral suture above and below, black. Abdomen dark brown or black, the segments darker apically; 3-7 with pale narrow basal rings; 8-10 blue. Legs dark and light.

Female.—When young are light brown; when fully adult, pale blue, like the males. The humeral spots are small or wanting, and the abdomen is darker; dorsum black, with the apical half of 9 and all of 10 yellow.

Maine, New York, District of Columbia, Virginia, Louisiana, Missouri, Pennsylvania, Illinois, Texas, Iowa, Michigan, Ohio, Indiana.

Wabash River, Wells County, June 22, 1898, common, pairing; June 5, 1899 (Dean *et al.*); Elkhart, city limits, July 30, 1899, rare (Weith); Shriner Lake, July 21, 1898, one male; St. Mary's River, Allen County, June 26, 1898, common; Frantz Fishpond, July 4, 1898.

Similar in color and habits to *putrida*; adults are distinguished as they fly by the brighter and clearer color of the thorax. The species may be looked for from June to September.

ERYTHROMMA Charpentier (*erythros* Gr., red; *omma* Gr., eye).

Charpentier, Lib. Eur., p. 20, 1840.

A genus represented in Europe, Asia and North America. Seven species are known, but three of these are questionably referred to the genus. It is doubtful if the single North American species, *Erythromma conditum* Hagen, is congeneric with the type of the genus, *E. najas* Hausmann, of Europe.

E. CONDITUM Hagen (*conditus* L., hidden).

E. (?) conditum Hagen, Bull. Ac. Belg. (2) XLI, p. 1305, 1876;
Kirby, Synonymic Cat., 1890.

Ab. male and female 28; h. w. male 21, female 23.

Male.—Blue; vertex, a mid-dorsal thoracic stripe, widened at the middle and above, and a spot under each wing, black; metepimeron bright yellow. Abdomen black, blue as follows: sides and apical rings on 1 and 2, interrupted basal rings on 3–7, and all of 8 and 9. Legs dark and pale. Superior appendages as long as 10, the apex dilated incurved; the inferiors are shorter, wedge-shaped in profile.

Female.—Darker and duller, younger individuals with light brown instead of blue; the yellow on the metepimeron wanting or darker than in the male. Abdomen with 2–10 black above, excepting interrupted basal rings on 3–7.

Maine, New York, Maryland, District of Columbia, Ohio, Western Pennsylvania (Graf, Atkinson).

May and June. This species frequents cool, shaded, swampy spots, where the vegetation is rank, along some stream or marsh. In such a place they may sometimes be found in large numbers, often associated with *Calopteryx maculata*.

NEHALENNIA Selys (*Nehalennia* L., name of a river goddess of the Rhine).

Selys, Rev. Od. d'Eur., p. 172, 1850.

A genus represented in Asia, Europe, and North and South America. Eight species are known. Three species occur in the United States, and two of these have been taken in Indiana. They prefer sheltered sedgy spots, where they may sometimes be found in great numbers.

Metallic green and blue; thorax above uniform in color. *irene*.

Bronze-black and yellow; thorax above with antehumeral stripes.
posita.

N. IRENE Hagen (a proper name).

Agrion irene Hagen, Syn. Neur. N. A., p. 74, 1861.

N. irene Kirby, Synonymic Cat., 1890.

Ab. male and female 21; h. w. male 13, female 14.

Male.—Metallic green; face, sides of thorax and below pale yellowish; a narrow occipital line. Abdomen metallic green, duller posteriorly; pale basal rings on 1–2; pale interrupted basal rings on 3–6; apex of 8 and most of 9 and 10 blue. Legs pale lined with dark, the tarsi ringed. Superior abdominal appendages short bifid, the inferiors longer.

Female.—Similar, the yellow on the thorax darker. The basal rings on the abdominal segments are narrower and the blue at the tip is confined to an apical spot on 9 and the greater part of 10.

Maine, New York, Massachusetts, New Jersey, Florida, Illinois, Wisconsin, South Dakota, Iowa, Ohio, Indiana.

Elkhart, margin of pond, June 11, 18 and 19, 1895, pairing June 19; city limits, July 14, 1899 (Weith); Marshall County, May 18, 1899 (Blatchley); Shriner Lake, June 24, 1898, one male, five females.

This small and beautiful species is distinguished at once by its bright green color. It is found from May till July in damp grassy places along some stream or near still water. It is easily overlooked by the collector, especially if the vegetation which it frequents is being moved by the wind.

N. POSITA Hagen (*positus* L., placed).

Agrion positum Hagen, Syn. Neur. N. A., p. 77, 1861.

N. posita Kirby, Synonymic Cat., 1890.

Ab. male and female 20; h. w. male 12, female 14.

Male.—Bronze black; face, sides of thorax and beneath yellow or yellowish; postocular spots round; a narrow occipital line; a yellow antehumeral stripe interrupted above to form a ! mark; second lateral suture with a black line. Abdomen bronze black, darker posteriorly; apical ring on 1, and basal rings on 3-7 yellow. Legs pale, lined with dark, tarsi ringed. Appendages yellow, short, the superiors a little larger than the inferiors.

Female.—Paler than the male; the antehumeral stripe sometimes not interrupted.

Quebec; Massachusetts, Pennsylvania, New York, District of Columbia, Georgia, New Jersey, Florida, Michigan, Ohio, Illinois (Adams), Indiana.

Elkhart, June 14, 1895, marsh, common; May 18 and 25, 1897, pond; city limits, July 14, 1899; Christiana Creek, May 21, 1897 (Weith); Lake, Jackson Township, Wells County, September 14, 1899 (Deam); Round and Shriner lakes, July 21, 1898, common; Eel River, Allen County, June 23, 1898, common; Wabash River, Wells County, July, 1896, rare.

A common species, flying from May till October. In life the male usually has the thorax bright colored, tinged with green. The divided antehumeral will usually distinguish the species. The length of abdomen may vary in different individuals as much as seven mm. or eight mm.

AMPHIAGRION Selys (*amphi* Gr., about; *Agrion*, a genus of Odonata; *agrion*, Gr., a wild animal).

Selys, Bull. Ac. Belg. (2) XLI, p. 284, 1876.

Four species have been described in this genus, which is confined to North America.

A. SAUCIUM Burmeister (*saucius* L., enfeebled).

Agrion discolor and *Agrion saucium* Burmeister, Handb. Ent. II, p.

819, 1839; Hagen, Syn. Neur. N. A. pp. 79 and 85, 1861.

Amphiagrion discolor Kirby, Synonymic Cat., 1890.

Agrion saucium Calvert, Burmeister's Types of Od., Trans. Am. Ent. Soc., Vol. XXV, p. 39, 1898.

Ab. male 20, female 21; h. w. male 14, female 15.

Male.—Dark brown or black; sides of thorax and under parts of head and thorax, pale reddish. Abdomen with 1–6 red, 6 usually with an apical black spot; 7 red basally; the rest of the segment and all of 8–10 blackish, usually with a narrow longitudinal red mid-dorsal stripe. The coloration of 7–10 is subject to considerable variation. Legs pale reddish, without or with but little dark. Superior abdominal appendages short; the inferiors longer, prolonged, slender and incurved.

Female.—Similar, paler; thorax dull reddish or yellowish. Abdomen with more black than usual in the males; 10 largely reddish.

Quebec; Maine, New York, Massachusetts, Pennsylvania, District of Columbia, Maryland, Illinois, South Carolina, South Dakota, Colorado, Ohio, Indiana.

Christiana Creek, May 21 and 25, 1897, and May 21, 1899; Elkhart, margin of pond, May 25, 1897; Indiana Lake, June 25, 1899 (Weith).

May to July. This species frequents the grassy banks of small streams. In such places, during the latter part of May they may sometimes be found in great numbers, often in couple, when a single sweep of the net may gather half a dozen pairs. In the field this red and brown species can be mistaken for no other, unless it is the orange female of *Isochnura verticalis*, from which it is distinguished by the greater amount of red on the abdomen.

ENALLAGMA Charpentier (*enallatto* Gr., to exchange, to differ from).

Charpentier, Lib. Eur., p. 21, 1840.

A genus of more than 40 known species, occurring in the Americas and the West Indies, Europe, Asia and Africa, Japan and the Malay Archipelago. The greater number are American, and more than a fourth of all the species are found within the State. To this genus belong the

most of our smaller dragonflies whose bright blue colors render them conspicuous about lakes and rivers during June and July. Representatives of this genus may be found from early May until late in September. The abdominal appendages of the males are beautifully characteristic of the species. The females are more difficult of determination, and often positive identifications are possible only by taking them in association with males.

The bright colors are very apt to fade, the entire insect becoming an ugly dull brown. Rapid drying usually preserves the colors fairly well. Specimens may be beautifully preserved in small vials of 95 per cent. alcohol. A large number of individuals may be dropped as soon as collected, into a large vial or jar of alcohol. After a few days they may be transferred to small vials, filled with fresh alcohol.

The following key, based on colors, applies only to males.

Dorsum of segment 2 blue with an apical black spot; rarely this spot extends forward to the base of the segment, but it is always narrowed anteriorly. 1.

Dorsum of segment 2 black. 6.

1. Dorsum of segments 3-5 at least one-third blue. 2.

Dorsum of segments 3-5 largely black. 3.

2. Segment 5 more than half blue. *doubledayi*, *hageni*, *ebrium* and *civile*.

Segment 5 with the blue and black about equal. *carunculatum*.

3. A distinct black spot on the side of segment 2. *geminatum*.

No distinct black spot on the side of segment 2. 4.

4. Segment 8 blue with a black spot at base. *traviatum*.

Segment 8 entirely blue. 5.

5. Segment 7 with apical half or three-quarters blue. *aspersum*.

Segment 7 black. *piscinarium*.

6. Dorsum of 8 and 9 blue. *divagans*.

Dorsum of 8 black, 9 blue or yellow. 7.

7. Face green or blue. *exsulans*.

Face yellow or yellowish. 8.

8. Thorax largely green or blue and black, tinged with pale yellow below. *antennatum*.

Thorax orange or yellow and black. 9.

9. Segment 9 yellow or orange. *signatum*.

Segment 9 pale blue. *pollutum*.

E. DOUBLEDAYI Selys (named for Edward Doubleday).

Agrion doubledayi Selys, Rev. Od., p. 209, 1850; Hagen, Syn.

Neur. N. A., p. 89, 1861.

Enallagma doubledayi Kirby, Synonymic Cat., 1890.

Ab. male 25, female 24; h. w. male 17, female 18.

Male.—Similar to *E. hageni*. The abdominal appendages are short, the superiors have the upper branch rectangular in profile, shorter than the lower obtuse branch; the inferiors are as long as the upper branch of the superiors and are turned upwards; the superiors bear a pale tubercle which projects beyond the darker part of the appendages.

Female.—Head and thorax yellowish where the male is blue. Dorsum of the abdomen dark green.

Florida, Massachusetts, Ohio.

This species has been taken in Ohio in May. *Doubledayi*, *hageni*, *ebrium*, *civile* and *carunculatum* are black and light blue—*bleu vif*—in coloration. On the wing the blue is most conspicuous, and the insect appears to be largely of this color. *Aspersum*, *traviatum*, *geminatum*, *piscinarium*, *divagans* and *exsulans* are black and darker blue—*bleu de ciel*—the black predominating when they are seen flying. *Antennatum*, *signatum* and *pollutum* are black and blue, green, yellow or orange.

E. HAGENI Walsh (named for Hermann August Hagen). Plate V, figs. 1 and 2.

Agrion hageni Walsh, Proc. Ent. Soc. Phila., II, p. 234, 1863.

E. hageni Kirby, Synonymic Cat., 1890.

Ab. male 23, female 22; h. w. male 16, female 17.

Male.—Blue; vertex black; postocular spots blue, large, usually connected. Thorax with mid-dorsal and humeral stripes black. Abdomen blue, black as follows: basal spot on 1, apical spot on 2, apical third or fourth of 3-5, apical half of 6, all of 7 but an interrupted basal ring, and dorsum of 10. Legs dark and pale.

Female.—Green; duller and paler. Dorsum of 2-10 black, 3-7 with pale basal rings.

Canada; Maine, New York, Massachusetts, Maryland, Missouri, Illinois, New Hampshire, Delaware, South Dakota, Wisconsin, Iowa, Ohio, Indiana.

Turkey Lake (Kellicott); Elkhart, June 11, 1895 (Weith); Crawford County, July 8, 1899 (Blatchley); Eagle Lake, July 5, 6, 9 and 12, 1898 (Deam); Round and Shriner lakes, June 7 and 24 and July 21, 1898, abundant, pairing on first two dates.

May, June and July. A species of the smaller lakes, usually abundant where found. On June 7 it was the most abundant *Enallagma* about Shriner and Round lakes, especially frequenting the strips of *Scirpus americanus* which grow on the shore and in the shallow water along the eastern part of Shriner.

E. EBRIUM Hagen (*ebrius* L., drunken). Pl. V, figs. 3 and 4.

Agrion ebrium Hagen, Syn. Neur. N. A., p. 89, 1861.

E. ebrium Kirby, Synonymic Cat., 1890.

Ab. male 25, female 24; h. w. male 17, female 18.

Male.—Blue with black markings similar to *E. hageni*, from which it may be at once distinguished by the abdominal appendages. Blue post-ocular spots large, connected.

Female.—The color is yellowish green where the male is blue and the dorsum of the abdomen is entirely dark green excepting basal rings on 2-7.

Nova Scotia; Maine, New York, Illinois, Missouri, Iowa, New Hampshire, Michigan, Ohio, Indiana.

Elkhart, June 11, 1895 (Weith).

E. CIVILE Hagen (*civilis* L., of citizens, civil). Pl. I; Pl. V, figs. 5 and 6.

Agrion civile Hagen, Syn. Neur. N. A., p. 88, 1861.

E. civile Kirby, Synonymic Cat., 1890.

Ab. male 25, female 27; h. w. male 18, female 20.

Male.—Blue and black, similar to the preceding species. The black on the apex of abdominal segment 6 usually occupies about two-thirds of the dorsum. The postocular spots are usually connected.

Female.—The blue of the male replaced by duller blue, or yellowish green. Dorsum of abdomen black, 3-7 with pale interrupted basal rings.

Canada, Mexico, West Indies; Maine, New York, Pennsylvania, Maryland, Virginia, District of Columbia, Missouri, Texas, South Dakota, New Mexico, California, Massachusetts, Michigan, Ohio, Illinois, (Adams) Indiana.

Frantz Fishpond, July 4, 1898, June 5, 1899, abundant, pairing on the former date (Deam *et al.*); Wabash River, Wells County, July, 1896.

May to September. Apparently this species is less common in Indiana than *carunculatum*, which it very much resembles in habits and appearance. Doubtless some of the State records as given for this species belong rather to *carunculatum*. Often old individuals of *civile* and *carunculatum*, and possibly of other species, have the wings slightly milky or gray and the pterostigma bluish or pruinose.

E. CARUNCULATUM Morse (*caruncula* L., a bit of flesh). Pl. V, figs. 7 and 8.

E. carunculatum Morse, Psyche, Vol. 7, p. 208, March, 1895.

Ab. male 25, female 26; h. w. male 19, female 20.

Male.—Blue; head and thorax with black markings similar to the preceding species; postocular spots connected. Abdomen blue, black as follows: basal spot on 1, apical spot on 2, apical third of 3, about apical half of two-thirds of 4 and 5, apical two-thirds or three-fourths of 6, all of 7 but a narrow basal ring, and all of 10. Legs dark and pale.

Female.—Indistinguishable from *E. civile*. In both species there is a great variation in size.

Nevada, Ohio, Illinois (Adams), Indiana.

Simonton Lake, July 9 and 14, 1899, common (Weith); Frantz Fishpond, July 4, 1898, June 5, 1899, rare (Deam *et al.*); Eagle Lake, July 5, 9 and 10, 1898 (Deam); Round and Shriner Lakes, September 2, 1897, and June 24 and July 21, 1898; Wabash River, Wells County, July, 1896.

June to September. The males of this species are most easily separated from *civile* structurally by the superior abdominal appendages, as seen in dorsal view. In profile the appendages of these two species sometimes appear obscure and indistinct.

E. ASPERSUM Hagen (*aspersus* L., spotted).

Agrion aspersum Hagen, Syn. Neur. N. A., p. 97, 1861.

E. aspersum Kirby, Synonymic Cat., 1890.

Ab. male 25, female 24; h. w. male and female 18.

Male.—Blue; vertex black; postocular spots blue, connected. Throat with mid-dorsal and humeral stripes black. Abdomen blue, black as follows: a basal spot on 1, an apical spot on 2, apical two-thirds of 3, all of 4–6 excepting narrow interrupted basal rings, basal half of 7, and 10. Legs dark and pale. The abdominal appendages are very similar to *E. traviatum*. In profile they may be distinguished as follows: *aspersum* has the lower lobe of the superiors more prominent than *traviatum*, so that in *aspersum* the inferior appendages just reach the tip of this lobe, in *traviatum* they extend far beyond it, almost equaling the upper lobe of the superiors.

Female.—Lighter than the male. Dorsum of 1–10 with a longitudinal black band, reduced to a narrow stripe on the greater part of 7 and 8; interrupted basal rings on 3–6.

New York, New Jersey, Illinois, New Hampshire, Pennsylvania, Virginia, Massachusetts, Ohio.

E. TRAVIATUM Selys (*traviatus* L., from *travio*, to go through). Pl. V, figs. 9 and 10.

E. traviatum Selys, Bull. Ac. Belg. (2) XLI, p. 519, 1876; Kirby, Synonymic Cat., 1890.

Ab. male 25, female 24; h. w. male 17, female 18.

Male.—Blue; vertex blue or green bounded with black lines; post-ocular spots connected. Thorax with the black mid-dorsal and humeral stripes narrow. Abdomen blue, black as follows: a basal spot on 1, an apical spot on 2, all of 3-7, excepting rather broad interrupted basal rings, a basal patch on 8, and all of 10. Legs dark and pale.

Female.—Similar to the male, paler. Mid-dorsal thoracic and humeral stripes largely reddish yellow with narrow black lines. Dorsum of abdomen black, blue as follows: interrupted basal rings on 3-7, 8 and 9 excepting basal spots, and all of 10.

New York, Massachusetts, Ohio, Indiana.

Round and Shriner lakes, June 24, 1898, abundant, pairing, females were common in adjoining woodland.

This delicate species has probably a very short seasonal range. Like several others of the genus—*hageni*, *aspersum*, *divagans*, *pollutum*—*traviatum* seems to confine itself pretty closely to the lakes and ponds.

E. GEMINATUM Kellicott (*geminus* L., twin). Pl. V, figs. 11 and 12.

E. geminata Kellicott, Ent. News, Vol. VI, p. 239, September, 1895.

Ab. male 20, female 19; h. w. male 14, female 15.

Male.—Blue; vertex black, postocular spots not connected. Thorax with wide mid-dorsal and humeral stripes, and a line on the second suture black. Abdomen blue, black as follows: a basal spot on 1, an apical spot on 2, the anterior point of this sometimes reaching the base of the segment, 3-6 excepting basal interrupted rings, all of 7 and 10. Legs pale and dark.

Female.—Similar, usually paler. Dorsum of abdomen black, an apical ring on 1, and widely interrupted basal rings on 3-7; 8 has a blue spot on either side—these spots are of variable size, sometimes meeting dorsally, making the basal half or three-fourths of the segment blue.

New York, Ohio, Michigan, Illinois (Adams), Indiana.

Elkhart, May 31, June 10, September 18, 1895, July 18, 1899 (Weith); Lake, Jackson Township, Wells County, September 14, 1899, common, pairing (Deam); Round and Shriner lakes, June 8 and 24, 1898, abundant on both dates; Eel River, Allen County, June 23, 1898; Frantz Fishpond, July 4, 1898.

May to September. The smallest and possibly the most active representative of the genus in the State. They are found near streams and ponds or lakes, but seem to prefer the still water, over which, during the middle of the day, they fly restlessly back and forth, usually several feet or more from the shore.

E. piscinarium n. sp. (*piscinarius* L., one found of fishponds). Pl. V, figs. 13 and 14.

Ab. male, 22; h. w. male 15.

Male.—Head blue, beneath pale; the following black: vertex, antennæ, excepting the first joint, and the clypeus; post-ocular spots rounded cuneiform, narrowly connected. Prothorax black, posterior lobe narrowly margined with blue; thorax blue, a mid-dorsal and humeral stripe and a spot on the first and second sutures just under the wing bases, black. Abdomen blue, black as follows: a basal spot and narrow apical ring on 1, a cordate apical spot connected with a narrow apical ring on 2, very narrowly interrupted basal rings on 3–6 (these rings are widest anteriorly, becoming narrower successively), all of 7 and 10; sides of 1 and 2 blue, posteriorly the black of the dorsum extending more onto the sides. Legs pale; femora above, tibia anteriorly, and tarsi entirely, dark, successively paler from the first pair to the third. Superior abdominal appendages black, inferiors pale, tipped with dark; very similar to *E. geminatum*. The superiors, like *geminatum*, have a small acute tooth on the lower inner surface of the lower lobe; the upper lobe is shaped very much as in *geminatum*, while the lower lobe is more developed than in that species, turning upward and lying outside of the upper lobe. Seen from above and from the side the superior appendages on the inner surface resembled a mittened hand, the upper lobe corresponding to the thumb, which lies half within the partly closed palm, represented by the lower lobe. The inferior appendages, viewed in profile, are more upturned than in *geminatum*, the upper edge is more concave, and they are relatively shorter.

Described from a single male. Franz Fishpond, Wells County, Indiana, July 4, 1898, L. A. Williamson. The specimen has been examined by Dr. Calvert and Mr. Hine. It is deposited in the Museum of Comparative Zoölogy, Cambridge, Mass.

The species is most nearly related to *E. geminatum* Kellicott. From that species it offers the following differences in coloration: Postocular spots connected in *piscinarium*, not connected in *geminatum*; a spot on the second lateral suture above in *piscinarium*, a well defined line in *geminatum*; abdominal segment 2 without a lateral spot in *piscinarium*, 2 with a large irregular rectangular spot in *geminatum*; and the basal rings on 3–6 slightly wider and less interrupted in *piscinarium* than in *geminatum*.

E. divagans Selys (*divagans* L., wandering). Pl. V, figs. 15 and 16.

E. divagans Selys, Bull. Ac. Belg. (2) XLI, p. 519, 1876; Kirby, Synonymic Cat., 1890.

Ab, male 23, female 24; h. w. male 16, female 18.

Male.—Blue; vertex black, blue postocular spots connected. Thorax with mid-dorsal and humeral stripes and a spot on the first and second sutures above, black. Dorsum of abdomen black, an apical ring on 1, narrow interrupted basal rings on 3–7, and all of 8 and 9, blue. Legs dark and pale.

Female.—Similar, paler; humeral stripe with reddish yellow on the suture. Dorsum of abdomen black, a large basal spot on 9 and all of 10 blue.

Massachusetts, Pennsylvania, New York, Ohio, Indiana.

Round and Shriner lakes, June 24, 1898, two males.

E. EXSULANS Hagen (*exsulans* L., being a stranger). Pl. V, figs. 17 and 18.

Agrion exsulans Hagen, Syn. Neur. N. A., p. 82, 1861.

E. exsulans Kirby, Synonymic Cat., 1890.

Ab. male 27, female 26; h. w. male 18, female 19.

Male.—Blue; vertex black, postocular spots connected. Thorax with mid-dorsal and humeral stripes and spots above the sutures, black. Dorsum of abdomen black, a narrow apical ring on 1, narrow interrupted basal rings on 3–6, the apical part of 8 and all of 9 blue. Legs pale and dark.

Female.—Similar, paler; the thorax has the mid-dorsal and humeral stripes bright dark green, each humeral enclosing a reddish yellow stripe which covers the suture; mid-dorsal carina yellow. Abdomen with the dorsum dark green, interrupted basal rings on 3–6, apex or not of 9 and usually all of 10 blue.

Maine, New York, Pennsylvania, Virginia, Maryland, District of Columbia, Illinois, Missouri, Texas, Michigan, Ohio, Indiana.

Elkhart, June 13, July 8, 1895, July 18, 1899 (Weith); Eagle Lake, July 6, 1898; Marion County, June 26, 1899 (Deam); Wabash River, Wells County, July, 1896, June 22, 1898, June 5, 1899 (Deam *et al.*); Round and Shriner lakes, June 24 and July 21, 1898, rare; Eel River, Allen County, June 23, 1898, abundant, pairing.

June to September. This very common species seems to prefer the herbage along streams, though it may be expected about every pond and lake. The male abdominal appendages seem to offer greater individual variations than are found in the same parts in any other species occurring in the State.

E. ANTENNATUM Say (*antenna*, L., a sail-yard). Pl. V, figs. 19 and 20.

Agrion antennata Say, Journ. Ac. Phila., VIII, p. 39, 1839.

Protonoura antennata Hagen, Syn. Neur. N. A., p. 73, 1861.

E. fischeri Kellicott, Journ. Cin. Soc. Nat. Hist., p. 206, January, 1895.

Ab. male and female 24; h. w. male 17, female 18.

Male.—Black, orange, blue and green; vertex black, face orange, blue postocular spots connected. Thorax black, a glaucous or yellow antehumeral stripe and the sides blue or greenish, excepting a black spot above on each of the sutures; beneath faintly tinged with yellowish. Abdomen with the dorsum black, the following blue: a narrow apical ring on 1, narrow interrupted basal rings on 3-6, and all of 9. Pterostigma small, square, a decided reddish brown. Legs yellow, lined with dark, the last pair the palest.

Female.—Similar, paler; the mid-dorsal thoracic carina yellow (sometimes so in the male also). Abdomen with dorsum bronze black, interrupted basal rings on 3-6 and most of 10 blue or pale. Pterostigma paler.

Ohio, New York, Iowa, Illinois (Adams), Indiana.

"Inhabits Indiana" (Say); Indiana Lake, June 25, 1899 (Weith); Eagle Lake, July 6, 1898 (Deam); Wabash River, Wells County, July and August, 1896, June 22, 1898, June 5, 1899; Frantz Fishpond, July 4, 1898, June 5, 1899 (Deam *et al.*); Eel River, Allen County, June 23, 1898, abundant; Round and Shriner lakes, June 7 and 24, 1898, common, pairing on both dates.

May to September. This common and beautiful species frequents the herbage near streams, lakes and ponds, where it may sometimes be found in great numbers. It is distinguished from all the other Agrionines as it flies by the orange or yellowish on the head and ventral part of the thorax as distinct from the black and blue or green of the remainder of the thorax. During the middle of August, 1896, it was by far the most abundant Odonate about a deserted gravel pit near the Wabash River in Wells County.

E. signatum Hagen (*signatus* L., marked). Pl. V, figs. 21 and 22.

Agrion signatum Hagen, Syn. Neur. N. A., p. 84, 1861.

E. signatum Kirby, Synonymic Cat., 1890.

Ab. male 28, female 27; h. w. male 17, female 18.

Male.—Orange; vertex black, orange occipital spots connected. Thorax with a mid-dorsal and humeral stripes and a line on the second suture bronze black or dark green, the humeral stripe sometimes has a lilac or greenish stripe of equal width lying just below it. Dorsum of abdomen black, the following orange or pale yellow: a narrow apical ring on 1, basal interrupted rings on 3-7, all of 9, and the sides of 10, sometimes reducing the black on the dorsum of 10 to a line. Pterostigma paler than in *antennatum*, longer than wide. Legs pale yellow with little or no dark.

Female.—Similar, usually more blueish than yellow. Dorsum of abdomen bronze black, 3-7 with yellowish, interrupted basal rings, 9 with the yellow on the sides reaching the mid-dorsum apically, and 10 entirely yellow. Legs with more dark than in the male.

Maine, New York, Maryland, Georgia, Louisiana, Illinois, Missouri, Pennsylvania, Massachusetts, Iowa, Michigan, Ohio, Indiana.

Turkey Lake (Kellicott); Elkhart, June 10, 1895, July 27, 1899 (Weith); Chapman Lake, July 7, 1898; Lake, Jackson Township Wells County, September 14, 1899, pairing (Deam); Wabash River Wells County, July, 1896, October 2, 1898 (Deam *et al.*); Round and Shriner lakes, August 1, 1896, September 2, 1897, June 7 and 24, and July 21, 1898, pairing on all dates but June 7; Eel River, Allen County, June 23, 1898, abundant.

June to September. A common species, graceful and active, preferring slow flowing or still water. At Shriner and Round lakes they were abundant on the dates given above; the females when not pairing or ovipositing were always found among the vegetation near shore; the brightest colored males are oftenest seen about the lily pads at a considerable distance from land. As in *pollutum*, teneral individuals are dull pale blue, where the adults are orange or yellow in color.

E. POLLUTUM Hagen (*pollutus* L., polluted). Pl. V, figs. 23 and 24.

Agrion pollutum Hagen, Syn. Neur. N. A., p 36, 1861.

E. pollutum Kirby, Synonymic Cat., 1890.

Ab. male 28, female 27; h. w. male 17, female 18.

Male.—Bright yellow, pale; vertex black, postocular spots blue, connected; thorax with a narrow mid dorsal stripe, a humeral spot above and below, joined with faint reddish, and a spot above on the second suture, bronze or green black; as in *signatum*, the humeral stripe has a pale indistinct bluish stripe below it. Dorsum of the abdomen greenish black or brown, segments usually darker apically, especially on the anterior segments, posterior segments darker, blue or pale, as follows: basal rings on 3-7, all of 9, and the sides of 10, extending well onto the dorsum. Legs pale yellow without dark lines or with the merest trace of such.

Female.—Similar, paler. Dorsum of abdomen bronze black, 3-7 with basal yellowish or pale rings, apex of 9 and all of 10 yellowish or bluish. Legs with more dark than in the male.

Maine, Florida, Ohio, Indiana.

Simonton Lake, July 13, 1899 (Weith); Round and Shriner lakes, September 2, 1897, June 7 and 24 and July 21, 1898, abundant at a few points around the lakes.

June to September. Color of tenerals pale blue, changing to yellow with age. The females of *signatum* and *pollutum* are distinguished by the

reduction of the thoracic mid-dorsal and humeral stripes in *pollutum*. *Pollutum* is the most slender and delicate of the *Enallagmas* found in Indiana. Along the shores of Shriner Lake the species occurs abundantly at a few places. During the middle of the day they will be found congregated in some cool, shady spot near the water's edge in such numbers that a single sweep of the net may capture half a dozen individuals. Like *signatum*, they are on the wing after sunset, often at a considerable distance from shore.

ISCHNURA Charpentier (*ischnos* Gr., lean; *oura* Gr., tail).

Charpentier, Lib. Eur., p. 20, 1840.

A widely distributed genus of about 30 known species. It is represented in North and South America, Europe, Asia, Africa, Australia and islands of the South Pacific. Two species are found in the State. *I. kellicotti*, so far as observed, confines itself to certain localities and surroundings, but *I. verticalis* is found everywhere, the males distinguished at once from the *Enallagmas* and other smaller species with which they commonly associate by the green and black thorax and the bright blue on abdominal segments 8 and 9.

The name *Ischnurus* was used in 1837 for a genus in *Arachnida*. The name *Ischnura* has been used, however, by all authors on Odonata during the past 50 years, and there seems no advantage to be gained by dropping it. If "all generic names are different unless originally spelled alike" (Jordan and Evermann, *Fishes of North and Middle America*, Part I, p. v, 1896), and if *Scaphirhynchus* and *Scaphorhynchus* can both exist, there seems no logical reason why *Ischnura* in Odonata may not be retained with *Ischnurus* in Arachnida. In his Synonymic Catalogue Kirby proposes the name *Micronympha* to take the place of *Ischnura*.

The females of species in this genus are dimorphic. That is, at the time of imagination two distinct color types of females appear. In *verticalis*, for example, the females may be greenish and brown or black, or the thorax and basal abdominal segments may be conspicuously reddish yellow. Later both forms become pruinose and the original colors are almost, if not completely, obscured. Such dimorphism is said to exist in other Agrionine genera, among them *Anomalagrion*, which is found in Indiana.

Male and black female.—Dorsum of 1 and 2 black; pterostigma on front wings of male usually black above.
verticalis.

Dorsum of 1 and 2 with more or less blue; pterostigma on front wings of male usually largely blue above. *kellicotti*.

Orange female.—Abdominal segments 2 and 3 largely orange. *verticalis*.
Abdominal segments 2 and 3 largely black. *kellicotti*.

I VERTICALIS Say (*vertex* L., the highest point). Pl. IV, figs. 6, 7 and 9.

Agrion verticalis Say, Journ. Ac. Phila. VIII, p. 37, 1839.

Agrion verticale and *Agrion ramburii* Hagen, Syn. Neur. N. A., p. 82 and p. 76, 1861.

Micronympha verticalis Kirby, Synonymic Cat., 1890.

-Ab. male 20, black female 21; orange female 22; h. w. male 13, black female 14, orange female 15.

Male.—Green; vertex black, small round, postocular spots and a short occipital line, blue. Thorax with wide mid-dorsal and humeral stripes, a spot above on the first suture, and a narrow line on the second suture, black, rarely the green stripe included between the mid dorsal and humeral stripes is interrupted to form an ! mark, as in *Nehalennia posita*. Dorsum of abdomen black, a narrow apical ring on 1 and narrow interrupted basal rings on 3-7 pale, 8 and 9 bright blue with a black stripe on either side. Pterostigma on front wings black, on hind wings pale brown. Legs pale and dark. The apical dorsal edge of 10 is produced as an upturned bifid process. The appendages are short, the superiors lamellate, triangular in profile; the inferiors a little longer, produced from the lower outer side, the upper lobe short and erect.

Black female.—Similar to the male, postocular spots connected or not; the humeral stripe is indistinct, usually black above and below, connected by reddish brown, sometimes represented by only a spot above; first and second sutures each with a spot above. Dorsum of abdomen uniform black or dark brown, sides paler, greenish. Pterostigma on all the wings pale brown. Usually smaller and slenderer, the head and thorax appreciably less robust, and the entire insect usually becoming less pruinose than the orange female. This description is made from alcoholic specimens. In life they are colored as follows: Bluish or grayish, pruinose; mid-dorsal thoracic and humeral stripes black; abdominal segments 1-7 with their apices darker, usually black, and 8-10 black.

Orange female.—Colors orange and bronze black; vertex black, postocular spots orange, connected; thorax with black as in the male, stripes narrower, and only a spot or short line on the second suture. Abdomen with 1-3 largely orange, apical half or third of 3 bronze black; dorsum of 4-10 bronze black, sometimes 8-10 are slightly marked with pale. This form becomes entirely pruinose, the orange entirely disappearing but remaining longest on the basal abdominal segments. In this coloration the postocular spots disappear or become dark brown; the black humeral stripe is bordered above (antehumeral stripe) and below by dark brown stripes; and the entire abdominal dorsum is black or dark brown; the sides of thorax and abdomen greenish. These markings

appear when the pruinose insect is dropped into alcohol. In the localities where the writer has observed this species the pruinose orange females in the spring have always been far more numerous than either the black females or the brightly colored orange females; in the autumn the black females seem to be most numerous.

Quebec to Georgia, west to Missouri and Louisiana, Iowa, Michigan, Ohio, Illinois, Indiana.

"Inhabits Indiana" (Say); Elkhart and vicinity; St. Joe River, Christiana Creek, Simonton Lake, June 10 and 11 and September 2, 1895, May 10 and 25, 1897, May 14, 19 and 21 and July 13, 14, 19, 27 and 30, 1899 (Weith); Crawford County, May 9, 1899 (Blatchley); Goose Lake, July 11, 1898; Eagle Lake, July 9, 1898; Lake, Jackson Township, Wells County, September 14, 1899 (Deam); Wabash River, Wells County, July and August, 1896, June 22, July 31 and September 4 and 10, 1898 (Deam *et al.*); Round and Shriner lakes, August 1, 1896, September 2, 1897, June 7 and 24 and July 21, 1898, observed pairing on all dates but June 7; Eel River, Allen County, June 23, 1898; Frantz Fishpond, July 4, 1898.

May to October; found everywhere. Their flight is so weak that wind storms often carry them far from their birthplace, and solitary individuals may be found perhaps resting on some dry paved thoroughfare. The pterostigma on all four wings in young males is brown; it is only in fully matured males that the pterostigma on the front wings is different in color from the pterostigma on the hind wings. This applies as well to *kellicotti*.

I. KELLICOTTI Williamson (named for David S. Kellicott).

I. kellicotti Williamson, Ent. News, Vol. IX, p. 209, November 1898; Calvert, l. c. p. 211.

Ab. male 21, female 22; h. w. male 15, female 16.

Male.—Blue; vertex black, postoculars blue, large, round and not connected. Thorax with wide, mid-dorsal and humeral stripes, a spot above on the first suture and a narrow stripe on the second, black. Abdomen above bronze black, the following blue: apex of 1, usually much of 2, the black on the sides extending across the segment apically and basally and near the middle, an apical spot on 7, and all of 8 and 9; pale interrupted basal rings on 3-7. Pterostigma of front wings mostly bright blue above in fully matured individuals, pale brown in hind wings. Legs pale and dark. Appendages black, longer and slenderer than in *I. verticalis*.

Black female.—Similar; postoculars continued onto rear of head. Dorsum of abdominal segments 8 and 9 usually largely blue, 3 some-

times blue only basally and apically, 10 blue. Pterostigma pale brown, the same on all four wings.

Orange female.—Similar to the black female but with orange or yellow replacing the blue.

New Jersey, Block Island off Rhode Island coast (Calvert), Indiana.

Round and Shriner lakes, September 2, 1897, June 7 and 24, and July 21, 1898.

Altogether 30 males and five females of this species has been taken in the State. Of the number, all but two males were taken in a small bay in the southwestern part of Round Lake. The two males were taken at the western end of Shriner Lake. They have been found only about the beds of white waterlilies, resting on the floating leaves. Their flight is usually short and direct, without the fluttering and hesitancy before alighting which makes the flight of other Agrionine species found associated with them. This species, and often *Enallagma geminatum* and *Enallagma signatum*, as well as others, is most easily captured by striking down with the insect net directly on the specimen and sinking the net with the captured dragonfly beneath the surface of the water. As the net is swept through the water and brought to the surface the dragonfly is found uninjured, clinging to the bag. *Kellicotti* may often be observed catching Diptera; in fact, unless disturbed, this seems to be its only reason for flying from one leaf to another, excepting when it suddenly darts at some trespassing *Enallagma*, usually *signatum*.

ANOMALAGRION Selys (*anomalos* Gr., irregular; *Agrion*, a genus of Odonata, *agrion* Gr., a wild animal).

Selys, Sagra's Hist. Cuba, Ins., p. 469, 1857.

A genus represented by a single species, reported from North America, Cuba and Venezuela.

A. HASTATUM Say (*hastatus* L., armed with a spear). Pl. IV, fig. 8.

Agrion hastata Say, Journ. Ac. Phila. VIII, p. 38, 1839.

A. hastatum Hagen, Syn. Neur. N. A., p. 77, 1861.

Anomalagrion hastatum Kirby, Synonymic Cat., 1890.

Ab. male 18, female 19; h. w. male 11, female 13.

Male.—Orange or yellow; vertex black, postocular spots small, not connected. Wide mid-dorsal thoracic and humeral stripes and spot above on the second suture, bronze black. Abdomen yellow or orange, bronze black on dorsum as follows: all of 1 and 2, much of 3, the basal and apical spots on 3 usually meeting on the mid-line, basal and apical spots, variable in size, on 4 and 6, and 7 basally. Pterostigma on front wings removed from the costa, ovate, reddish; on hind wings normal in

position, black. Legs pale, dark lined. Posterior dorsal edge of 10 bears a slender bifid spine. Superior abdominal appendages half as long as 10, bifid; inferiors a little longer than the superiors.

Black female.—Similar to the male; dorsum of abdomen black, pale interrupted basal rings on 3-6. Pterostigma brown, similar on all the wings.

Orange female.—Similar to the male; postocular spots continuous with orange on rear of head; thoracic humeral stripe reduced to a line or wanting. Abdomen with spot on the middle of 1, at base of 2, apical rings on 2-4 and all of 5 or 6-8 or 9 bronze black.

Venezuela, West Indies; Maine, Pennsylvania, New Jersey, New York, Maryland, Florida, Louisiana, Texas, Iowa, Ohio, Illinois (Adams), Indiana.

“Inhabits Indiana” (Say); Lake, Jackson Township, Wells County, June 21, 1899 (Deam); Elkhart, St. Joe River, July, 1899 (Weith).

May to September. A common species, to be looked for in marshes and swamps bordering streams or still water.

TACHOPTERYX Uhler (*tachys* Gr., swift; *pteryx* Gr., wing).

Uhler, Bull. Ac. Belg. (2) VII, p. 551, 1859.

A genus of three known species. Two occur in North America, the third in Japan. *Tachopteryx* is one of the four genera which constitute the Legion *Petalura* of Selys. They differ from all other genera in the subfamily *Gomphinae* by having the median lobe of the labium bifid and by the females having an ovipositor.

T. THOREYI Hagen (named for M. Thorey).

Uropetala thoreyi Hagen, Mon. Gomph., p. 373, 1857.

Petalura thoreyi Hagen, Syn. Neur. N. A., p. 117, 1861.

Tachopteryx thoreyi Selys, Bull. Ac. Belg. XLVI, p. 696, 1878;
Kirby Synonymic Cat., 1890.

Ab. male 56, female 54; h. w. male 51, female 52.

Male.—Gray, plumbeous or yellowish; head above dark, face yellowish with black, occiput yellowish, bordered with black. Thoracic sutures black, a wide, rather indefinite stripe on the humeral and another on the second lateral suture. Abdomen with black as follows: four spots on the dorsum of 1, the apical two the smaller, and a narrow interrupted transverse median ring, apical half and basal spot connecting on 3-7, and most of 8-10. Pterostigma very long and narrow; front wings with about 15 antecubitals and 9 postcubitals; triangle of front wings usually twice crossed and of hind wings once. Superior abdominal appendages flattened, apical portion triangular; the inferior shorter, near its base with two superior recurved teeth.

Female.—Similar; basal spots on 3–7 less distinct.

Massachusetts, New York, North Carolina, Maryland, Kentucky, Texas, Florida, Pennsylvania (J. L. Graf, H. D. Merrick).

T. thoreyi has been taken by the writer in western Pennsylvania. It was usually observed resting in sunny situations on fences or trees, at the edges of woodland. A small stream and a small marshy area were near. While resting they are very easily approached, and the net may be brought within an inch of them without disturbing them. In fact, they may be touched with the rim of the net and still remain at rest. Once aroused, their flight is swift and strong. Mr. Graf has observed the species in Allegheny County, Pa., from June 1 until July 16.

HAGENIUS Selys (named for Hermann August Hagen).

Selys, Bull. Ac. Belg. XXI (2), p. 82, 1854.

The type of the genus is *H. brevistylus*, found in North America and Colombia. A species from India has been provisionally referred to *Hagenius*. These are the only species of the genus known.

H. BREVISTYLUS Selys (*brevis* L., short; *stylus* L., a style).

H. brevistylus Selys, Bull. Ac. Belg. XXI (2), p. 82, 1854;
Hagen, Syn. Neur. N. A., p. 114, 1861; Kirby, Synonymic
Cat., 1850.

Ab. male 55, female 60; h. w. male 48, female 52.

Male.—Black, marked with greenish yellow; face yellow. Mid-dorsal thoracic carina a short curved line on either side, a transverse line in front, a narrow antehumeral stripe, usually interrupted, and two broad stripes on the sides and a line between them, yellow. Abdomen black, the following yellow: a median longitudinal stripe running nearly the length of the abdomen and ending on the base of 8, sides of 8 and 9, sides anteriorly, and beneath the entire length. Wings slightly tinged with brown; pterostigma long; front wings with about 20 antecubitals and 15 postcubitals. Abdominal appendages shorter than 10; superiors curved downwards at the apex, forming a hook, anterior to which there are two downwardly projecting processes; inferior about equal to superiors, wide, apex broadly bifid, upturned.

Female.—Similar; occiput small, hind border with a small posterior tubercle on each side. Vulvar lamina covering about a fourth of 9, apical margin excavated.

Colombia, Canada; Maine, New York, Massachusetts, Maryland, Wisconsin, Kansas, Texas, Florida, Kentucky, Michigan, Pennsylvania, Ohio, Illinois (Adams), Indiana.

Elkhart, July 5, 1893, one female; September 4, 1895, three nymphs; June 20, 1897, one male at edge of thick woods; June 1, 1899, one male in woods (Weith).

June, July and August. Apparently preferring the larger and more swiftly flowing streams, resting on the twig or branch of some near by shrub or tree, or hunting along the shore near the surface of the water, revisiting the same spot time and again.

PROGOMPHUS Selys (*pro* Gr., before; *Gomphus*, a genus of Odonata, *gomphos* Gr., a wedge-shaped bolt).

Selys, Bull. Ac. Belg. XXI (2), p. 69, 1854.

A genus confined to the Americas. Eleven species are known. One of these occurs north of Mexico and the West Indies.

P. OBSCURUS Rambur (*obscurus* L., dusky). Pl. IV, figs. 3 and 4.

Diastatomma obscurum Rambur, Ins. Névr., p. 170, 1842.

Progomphus obscurus Hagen, Syn. Neur. N. A., p. 110, 1861;

Selys, Bull. Ac. Belg. XLVI (2), p. 658, 1878; Kirby, Synonymic Cat., 1890.

Ab. male and female 43; h. w. male 32, female 33.

Male.—Brown, marked with greenish yellow; face and occiput greenish, occiput nearly straight, two yellow spots behind each eye. Thorax with the following markings: each side above with an oblique line which meets a transverse line anteriorly, and a narrow interrupted antehumeral stripe; sides indefinitely brown and green. Abdomen above with the apices of 2-7 brown, widest on 5 and 6, 7 with a brown spot on either side near the middle, 8-10 uniform brown. Wings with a small brown basal spot; in front wings about 15 antecubitals and 8 postcubitals. Legs small, yellowish brown, pale beneath. Superior abdominal appendages pale yellow, about twice as long as 10; inferior a third shorter than the superiors, brown, a dorsally directed process before the apex.

Female.—Similar; the abdomen darker, the greenish yellow reduced to basal spots, or anteriorly appearing as an interrupted longitudinal mid-dorsal stripe.

Mexico; Massachusetts, Pennsylvania, Georgia, Texas, Oregon, California, Ohio, Illinois (Adams), Indiana.

Elkhart, July 4, 1895, over marsh; Simonton Lake, July 8, 1895, and July 9, 1899 (Weith); St. Mary's River, Ft. Wayne, June 26, 1898, not rare at the ripples, a pair taken resting on a boulder in mid-stream.

GOMPHUS Leach (*gomphos* Gr., a wedged shaped bolt or nail).

Leach, Edinb. Encyc. IX, p. 137, 1815.

As used by Selys, the genus *Gomphus* includes more than 50 known species. About 20 of these are found in Europe, Asia or Africa and the

remainder occur in North America. No less than 15, and possibly a greater number of species will eventually be found in the State. Selys. Bull. Ac. Belg. XXI (2), 1854, divides the genus into 7 groups with the following types:

- I. *G. occipitalis* from India, since made the type of another genus. The species referred to this group of the genus *Gomphus* in 1854 have been transferred to two other genera.
- II. *G. dilatatus* from the United States.
- III. *G. vulgatissimus* from Europe.
- IV. *G. pallidus* from the United States.
- V. *G. parvulus* from the United States.
- VI. *G. plagiatus* from the United States.
- VII. *G. notatus* from the United States.

Species representing groups II-VII, excepting V, will doubtless be found in the State. Needham, Canadian Entomologist, July, 1897, after studying the nymphs or a number of species, groups the N. A. species of the genus *Gomphus* under four genera, as follows:

- I. *Lanthus*, type *G. parvulus*, = Group V.
- II. *Arigomphus* (*Orcus*), type *G. pallidus*, = Group IV.
- III. *Stylurus*, type *G. plagiatus*. This genus includes Groups VI and VII of Selys.
- IV. The name *Gomphus* is retained for Groups II and III of Selys.

In the present paper it is deemed advisable to use the name *Gomphus* in its wider sense. Kirby, in his Synonymic Catalogue, uses the name *Aeshna* of Fabricius for this genus. As has been pointed out (Selys., Needham) the name *Gomphus* should be retained.

The *Gomphi* are strong fliers and some of them are among our most wary dragonflies. As imagoes the males are much oftener taken than the females. Many species prefer the rocky, rapid ripples of some stream, flying back and forth near the water's surface, and taking long rests on some sunny boulder. Others frequent the shores of lakes and ponds. Some species are frequently met with in open fields and along sunny roads. The females are more retiring than the males. Of the material collected in the State, in every species excepting *G. exilis*, the males have greatly exceeded the females in numbers. Excepting *spiniceps*, which flies from July till September, the various species may be looked for from May till July. June is the Odonate month as far as the *Agrioinæ* and *Gomphinæ* are concerned. Later summer brings the *Aeshninæ* and the *Libellulinæ*, but it is during June, that in Indiana the maximum number of species is on the wing.

Coloration usually offers specific characters. Structurally the abdominal appendages and genitalia of the male, and the occiput and vulvar lamina of the female are distinctive.

Groups of Selys. in which the species known or likely to occur in Indiana fall :

II. *Dilatatus, vastus, ventricosus, crassus.*

III. *Quadricolor, fraternus, externus, grasilinellus.*

IV. *Pallidus, villosipes, furcifer, sordidus, spicatus, descriptus, exilis.*

VI and VII. *Notatus, amnicola, spiniceps, plagiatus, segregans.*

Abdominal segment 9 not longer than 8; thorax colored much as in figs. 2 or 3, Pl. VII; males with 7-9 conspicuously dilated, superior abdominal appendages black. 1.

Abdominal segment 9 usually equal to or longer than 8; thorax colored much as in figs. 1 or 4, pl. VII; males with 7-9 less expanded, superior abdominal appendages yellow or brown, rarely black. 9.

1. Segments 7-9 greatly dilated. 2.

Segments 7-9 moderately dilated. 5.

2. Abdomen more than 40 in length. 3.

Abdomen less than 40 in length. 4.

3. Abdomen more than 45 in length. *dilatatus.*

Abdomen less than 45 in length. *crassus.*

4. Humeral and antehumeral black stripes not-meeting. *vastus.*

Humeral and antehumeral black stripes joined for some distance. *ventricosus.*

5. Dorsum of 9 black. 6.

Dorsum of 9 with some yellow. 7.

6. Abdomen about 32 in length. *quadricolor.*

Abdomen about 40 in length. *externus.*

7. Superior surface of all the tibiae not yellow or green. 8.

Superior surface of all the tibiae yellow or green. *grasilinellus.*

8. Posterior edge of the inferior abdominal appendage of the male, seen from above, straight; occiput of the female with a median spine. *fraternus.*

Posterior edge of the inferior abdominal appendage of the male seen from above, concave; occiput of the female without a spine. *externus*

9. Thorax pale with dark markings, the pale area on the dorsum of the thorax on either side of the mid-dorsal dark area continuous with the pale anterior edge of the meso-thorax (fig. 1, pl. VII). 10.

Thorax dark with pale markings, the pale stripe or bar on the dorsum of the thorax on either side of the mid-dorsal dark area not meeting the pale mesothoracic half-collar (fig. 4, pl. VII). 16.

10. Thorax with the brown markings pale and obsolete, sides with little or no brown. *pallidus*.
Thorax darker, humeral and antehumeral not widely separated.
11.
11. Abdomen about 34 or more in length. 12.
Abdomen about 31 in length. *exilis*.
12. *Villosipes, furcifer, sordidus, spicatus, descriptus*: the males may be separated by their abdominal appendages (pl. VII); the females may be distinguished as follows:
Occiput with a spine or prominence in the middle. 13.
Occiput without median spine or prominence. 14.
13. Colors dark brown or black and olive. *villosipes*.
Colors obscure dull brown and olive. *spicatus*.
14. Abdominal segment 9 with a yellow mid-dorsal stripe; colors dull brown and olive. *sordidus*.
Abdominal segment 9 above brown or black. 15.
15. Apices of the vulvar lamina rounded. *furcifer*.
Apices of the vulvar lamina pointed, divaricate. *descriptus*.
16. Abdomen less than 38 in length. *annicola*.
Abdomen about 40 or more in length. 17.
17. Segment 7 and 9 about equal in length. *spiniceps*.
Segment 7 much longer than 9. 18.
18. Black, marked with yellow and green; stripes or bars on thorax above usually separated from meso-thorax half-collar by more than their own width; antehumeral narrowed or interrupted above. *notatus*.
Fuscous, marked with yellow and green; stripes on thorax above longer, more nearly reaching the meso-thoracic half-collar; antehumeral of uniform width. *plagiatus*.

G. DILATATUS Rambur (*dilatatus* L., broadened). Pl. VI, fig. 6.

G. dilatatus Rambur, Ins. Névr., p. 155, 1842; Hagen, Syn. Neur. N. A. p. 103, 1861.

Aeshna dilatata Kirby, Synonymic Cat., 1890.

Ab. male 52, female 47; h. w. male and female 40.

Male.—Yellow marked with black; head yellow, borders of labrum, a transverse line between clypeus and frons, and vertex black. Thorax with the following black: a stripe on either side of the mid-dorsal carina not reaching the front margin, a humeral and antehumeral stripe, and lines on the first and second sutures. Abdomen black above, a mid-dorsal yellow stripe on 1-4, and long yellow apical spots on 5-7; sides of 1 and 2 and spots on the sides of 8 and 9, yellow. Pterostigma yellow;

costa yellow. Legs black, the femora of the first pair yellow beneath. Abdominal segments 7-9 greatly dilated.

Female.—Similar to the male. Abdominal segments 7-9 less dilated. Vulvar lamina elongate, bifid, the apices separating.

Michigan, Georgia, Florida, Ohio.

G. VASTUS Walsh (*vastus* L., large). Pl. VI, figs. 3, 5 and 28.

G. vastus Walsh, Proc. Ac. Phila., p. 391, 1862.

Aeshna vasta Kirby, Synonymic Cat., 1890.

Ab. male and female 38; h. w. male 30, female 32.

Male.—Black, marked with greenish yellow; head with the following green: occiput, median part of frons, post-clypeus below, and labrum on either side above. Thorax black with diverging stripes above, which meet the interrupted mesothoracic semicollar below and join above with a narrow antehumeral stripe, and sides, excepting the distinct lines on the first and second sutures, greenish yellow. Abdomen black; 1 and 2 above greenish yellow; an indistinct interrupted longitudinal yellow stripe on 3-7, ending on the base of 7; sides of 1 and 2 greenish, 7 shaded with yellowish, 8 with a basal spot, and 9 largely, bright yellow. Costa green on its anterior edge. Legs black, femora of the first pair green beneath. Segment 7-9 greatly dilated.

Female.—Similar. Segments 7-9 less dilated. Vulvar lamina with its two points turned inwards and upwards.

Quebec; New York, Massachusetts, Maryland, District of Columbia, Illinois, Pennsylvania, Iowa, Michigan, Ohio, Indiana.

Elkhart, May 17, 1896, at edge of grove, five males, three females (Weith).

This common species may be expected along the Ohio River or, in fact, any of the larger rivers or lakes of the State. The males are oftener found near the water's edge, the females in some field or along some country road.

G. VENTRICOSUS Walsh (*venter* L., the abdomen).

G. ventricosus Walsh, Proc. Ent. Soc. Phila., II, p. 248, 1863;

Selys, Bull. Ac. Belg. XLVI (2), p. 453, 1878.

Aeshna ventricosa Kirby, Synonymic Cat., 1890.

Ab. male 33, female 35; h. w. male 28, female 30.

Male.—Differs from *G. vastus* in the following points: face without black; median thoracic black area with the sides parallel, not wider below; humeral and antehumeral black stripes confluent for some distance; that is, the antehumeral yellow stripe reduced (in *vastus* not at all); and one pleural stripe. There are other differences, but these will

separate *ventricosus* from *vastus* and other nearly related species. Abdominal segments 8-10 are black above, and the appendages are distinct.

Female.—Similar to the male. Abdomen more robust. Vulvar lamina similar to *vastus*, the pointed tips more divaricate.

Massachusetts, Virginia, Michigan, Illinois.

G. CRASSUS Hagen (*crassus* L., thick).

G. crassus Hagen, Bull. Ac. Belg. XLVI (2), p. 453, 1878.

Aeshna crassa Kirby, Synonymic Cat., 1890.

Ab. female 43; h. w. female 36.

Male.—Not known.

Female.—Described as much resembling *externus*, with the following as some of the differences: a conical brown spine between the lateral ocellus and the eye (in *externus* a yellow spine *behind* the ocellus); the line on the first lateral suture of the thorax is narrow and interrupted, on the second suture the line is wider; abdomen very robust; the dorsal stripe on 2 is not trilobed; and the vulvar lamina constricted near its base, then enlarging in two flattened pointed diverging lobes (in *externus* the lamina is not constricted and the two lobes are contiguous to near their apices, when they widely diverge).

Kentucky.

The above description is taken from Hagen's original description. The vulvar lamina as here described for *crassus* agrees with the vulvar lamina of the form called *externus* by Kellicott in *The Odonata of Ohio*. The description given above of the vulvar lamina of *externus* agrees with the form called *fraternus* in the *Odonata of Ohio*. Possibly the *externus* of the *Odonata of Ohio* should be *crassus*, though the Kentucky specimen is larger than Ohio and Indiana specimens.

G. QUADRICOLOR Walsh (*quattuor* L., four; *color* L.). Pl. VI, figs. 7 and 29.

G. quadricolor Walsh, Proc. Ent. Soc. Phila. II, p. 248, 1863.

Aeshna quadricolor Kirby, Synonymic Cat., 1890.

Ab. male and female 32; h. w. male 26; female 27.

Male.—Bluish green, marked with black; face olive. Thorax with the following black: a mid dorsal stripe, wider below and not reaching the anterior edge, a humeral and antehumeral stripe, equal in width, connected above and below, and the first and second sutures and most of the space between them. Abdomen black above, a longitudinal mid-dorsal stripe on 1-3, very narrow on 3, and small basal spots on 4-8, yellow or green; sides of 1 and 2 largely greenish, and 8 and 9 largely

bright yellow. Costa yellowish, pterostigma light brown. Legs black. Abdominal segments 7-9 moderately expanded.

Female.—Similar, more robust. Abdominal segments 7-9 less expanded, the yellow duller. Vulvar lamina short, emarginate.

Massachusetts, Michigan, Illinois, Ohio, Indiana.

Elkhart, May 5, 1896, a male, probably *quadricolor*, in a road (Weith); St. Mary's River, Ft. Wayne, June 26, 1898, one male, taken at a rapid stony ripple, others seen.

G. FRATERNUS Say (*fraternus*, L., brotherly). Pl. VI, figs. 8, 9 and 30.

Aeshna fraterna Say, Journ. Ac. Phila. VIII, p. 16, 1839.

Gomphus fraternus Hagen, Syn. Neur. N. A., p. 104, 1861.

Aeshna fraterna Kirby, Synonymic Cat., 1890.

Ab. male 37, female 38; h. w. male 30, female 32.

Male.—Yellowish green or olive, marked with dark brown; face greenish, without black. Thorax with the following brown: a mid-dorsal stripe, not reaching the anterior edge, an antehumeral equal in width to the mid-dorsal stripe, a slightly narrower humeral, a line on each of the lateral sutures and a short line or spot between them below. Abdomen black above, with a longitudinal mid-dorsal stripe, olive anteriorly where it is widest, and yellow posteriorly, ending as yellow basal spots on 7-8 or 9; sides of 1 and 2 and part of 3 greenish; lateral basal spots on 7 and 8, and all of the side of 9, yellow. Pterostigma brown, costa yellow. Legs mostly black. Segments 7-9 laterally expanded.

Female.—Similar, usually more yellowish. Humeral and antehumeral stripes connected above. Abdomen more robust; 7-9 less dilated. Vulvar lamina reaching the middle of 9, bifid, the apices diverging.

New York, New Hampshire, Texas, Illinois, Michigan, Ohio, Indiana.

“Common in June on the banks of the Wabash” (Say); St. Mary's River, Ft. Wayne, June 26, 1898, common about stony ripples.

G. EXTERNUS Hagen (*externus* L., strange, external). Pl. VI, figs. 2, 10 and 31.

G. externus Hagen, Mon. Gomph., p. 411, 1857; Syn. Neur. N. A., p. 104, 1861.

Aeshna externa Kirby, Synonymic Cat., 1890.

Ab. male 40, female 41; h. w. male 32, female 33.

Male and female.—Very similar to *fraternus*, slightly larger, and body color usually more greenish or olive than in that species. In *fraternus* abdominal segment 9 is usually black above in both sexes; in *externus* it has a yellowish longitudinal stripe or basal spot. In *externus* the males

have the abdominal appendages slenderer than in *fraternus*; viewed from above, the posterior edge of the inferior between its two branches is concave in a continuous curve with these branches; in *fraternus* the posterior edge is straight. The females may be distinguished by the shape of the occiput. (See pl. VI.)

Nebraska, Illinois, New Mexico, Texas, Ohio, Indiana.

Wabash River, Wells County, June 22, 1898, about stony ripples, many seen, several males taken.

This species, as determined by Professor Kellicott, is not *externus*, according to Dr. Calvert and Mr. Adams, as is shown by specimens in the M. C. Z. The true *externus* has the abdominal appendages distinctly different from either *fraternus* or *externus* as determined by Kellicott. Probably two species have been confused under the name of *fraternus*, so that either the *fraternus* or *externus* of the *Odonata of Ohio* and of the present paper possibly represents an undescribed species. (See *G. crassus*.) The vulvar lamina of the two species designated in this paper may be distinguished as follows: *externus*—constricted near the middle, bifid just beyond the constriction, the lobes gradually tapering, divaricate, acute (from a drawing by Mr. Hine); *fraternus*—bifid, lobes slightly tapering, contiguous till just at their tip where they turn outward at right angles, apex obtuse.

G. GRASLINELLUS Walsh (diminutive of *G. grastini*, named for A. D. de Grastin). Pl. VI., figs. 11, 12 and 32.

G. grastinellus Walsh, Proc. Ac. Phila., p. 394, 1862.

Aeshna grastinella Kirby, Synonymic Cat., 1890.

Ab. male 36, female 37; h. w. male 31, female 32.

Male and female.—Similar to *fraternus*, color more yellowish. Humeral and antehumeral stripes often connected for their entire length in the female; both sexes with the stripes on the first and second lateral sutures wider than in *fraternus* or *externus*. Abdomen above with more yellow. Dorsum of 9 and 10 conspicuously yellow; sides of 8–10 with more yellow. Tibiæ of all the legs with a green stripe on the upper side.

Illinois, Ohio, Indiana.

Marshall County, May 18, 1899 (Blatchley); Frantz Fishpond, July 4, 1898, one male and one female, the female taken while ovipositing among the algæ much after the manner of *Libellulas*.

Grastinellus is apparently very common at certain times and places. It is often taken along larger streams.

G. PALLIDUS Rambur (*pallidus* L., pale). Pl. VI, fig. 13.

G. pallidus Rambur, Ins. Névr., p. 163, 1842; Hagen, Syn. Neur. N. A., p. 105, 1861.

G. pilipes Hagen, Syn. Neur. N. A., p. 106, 1861.
Aeshna pallida Kirby, Synonymic Cat., 1890.

Ab. male 39, female 37; h. w. male 32, female 33.

Male.—Olive, with pale brown markings; occiput and face greenish. Thorax with the median brown area pale, obsolete; the humeral and antehumeral separate; little or no brown on the sides. Abdomen brown, with an interrupted yellow dorsal band on 1-7. Costa, yellow. Femora beneath and tibiæ above, greenish.

Female.—Similar. Occiput slightly concave. Vulvar lamina bifid at its extremity.

Georgia, Louisiana, Illinois (Adams), Indiana.

Christiana Creek, May 26, 1897, one female (Weith).

G. VILLOSIPES Selys (*villosus* L., hairy; *pes* L., foot). Pl. VI, figs. 1, 14 and 33.

G. villosipes Selys, Bull. Ac. Belg. XXI (2), p. 53, 1854; Hagen, Syn. Neur. N. A., p. 105, 1861.

Aeshna villosipes Kirby, Synonymic Cat., 1890.

Ab. male 38, female 39; h. w. male 33, female 34.

Male.—Olive, marked with dark brown; face and occiput greenish, the latter with a median spine. Thorax with the following brown: a short narrow stripe on either side of the mid-dorsal carina, a short antehumeral stripe, a humeral of equal width, and indistinct lines on the first and second sutures. Abdomen black, an interrupted yellowish green longitudinal mid-dorsal stripe indistinct or wanting on 8 and 9, 10 and the superior appendages entirely yellow; sides greenish or yellow, reduced to linear spots on 4-6. Pterostigma light brown; costa yellow. Legs black; the first femora beneath and all the tibiæ above green.

Female.—Similar; stouter; abdomen with more yellow on the sides. The occipital spine is simple or several pointed. Vulvar lamina short, bifid, the apices contiguous.

Massachusetts, Michigan, Pennsylvania, New York, Ohio.

The writer has taken this species in western Pennsylvania near Pittsburg in a marsh with a small area of open water. The few specimens observed were resting on railroad ties which were floating in the water.

G. FURCIFER Hagen (*furca* L., a two-pronged fork; *fero* L., to carry).
Pl. VI, figs. 15 and 16.

G. furcifer Hagen, Bull. Ac. Belg. XLVI (2), p. 458, 1878.
Aeshna furcifer Kirby, Synonymic Cat., 1890.

Ab. male 35, female 36; h. w. male 28, female 30.

Male and female.—Similar to *villosipes*. The humeral and antehumeral stripes sometimes united above. Distinguished from *villosipes* in both sexes by the absence of the occipital spine; the abdominal appendages of the male are distinctive.

Massachusetts, Michigan, Ohio.

Furcifer is said to frequent still or sluggish bodies of water.

G. SORDIDUS Hagen (*sordidus* L., dirty, sordid). Pl. VI, figs. 17 and 34.

G. sordidus Hagen, Bull. Ac. Belg. XXI (2), p. 54, 1854; Syn. Neur. N. A., p. 106, 1861.

G. minutus (excepting male) Calvert, Phila. Cat., p. 244, 1893.

G. lividus Kellicott, Od. Ohio, p. 66, 1899.

G. umbratus Needham, Can. Ent., p. 184, July, 1897.

For the above synonymy I am indebted to Dr. Calvert.

Ab. male 35, female 36; h. w. male 30, female 32.

Male.—Olive, marked with brown; face and occiput greenish. Thorax with the extent of the brown markings very variable, usually as follows: a brown stripe on either side of the mid-dorsal carina, not reaching the anterior edge, an antehumeral and humeral stripe, joined above and below, and first and second sutures and much of the sides indistinctly. Abdomen brown, a maculate longitudinal mid-dorsal yellow stripe; 9 above entirely yellow; 10 and the appendages brown; sides greenish or yellow, reduced to basal spots on 3-7. Pterostigma light brown; costa yellow. Femora brown; tibiae black, green above.

Female.—Similar. Vulvar lamina short, bifid.

South Carolina, Pennsylvania, Georgia, Ohio, Indiana.

Christiana Creek, May 25, 1897, one female; June 1, 1897, two males (Weith).

This species seems to live along the smaller rivers and streams.

G. SPICATUS Hagen. (*spica* L., a point, a spike). Pl. VI, figs. 18 and 35.

G. spicatus Hagen, Bull. Ac. Belg. XXI (2), p. 54, 1854; Syn. Neur. N. A., p. 107, 1861.

Aeshna spicata Kirby, Synonymic Cat., 1890.

Ab. male and female 36; h. w. male 29, female 30.

Male and female.—Very similar to *sordidus*. Abdomen above and on the sides with more greenish and yellow. Female with the vulvar lamina short, deeply and broadly bifid. From *sordidus* this species may be distinguished by the abdominal appendages of the males and the occipita or the females.

Canada; Massachusetts, Maine, New York, Ohio, Indiana.

Shriner Lake, June 8, 1898, many males, one female taken, common, flying over the water near the shores of the lake.

“*Spicatus* frequents the borders of wave-beaten shores or rushing rivers.”—Kellicott.

G. *DESCRIPTUS* Banks (*descriptus* L., described). Pl. VI, fig. 19.

G. descriptus Banks, Journ. N. Y. Ent. Soc. IV, p. 194, 1896.

Ab. male and female 35; h. w. male 30, female 31.

Male and female.—Similar to *sordidus*. In the male abdominal segments 9 and 10 above and the appendages are black; in the female the abdomen is more yellow, and 10 has a mid-dorsal longitudinal stripe. Occiput of female slightly concave in the middle. Vulvar lamina one-third as long as 9, the apical half bifid, the tips acute and divaricate.

New York, Illinois (Adams).

G. *EXILIS* Selys (*exilis* L., small). Pl. VI, figs 20, 21 and 36.

G. exilis Selys, Bull. Ac. Belg. XXI (2), p. 55, 1854; Hagen, Syn. Neur. N. A., p. 108, 1861.

Aeshna exilis Kirby, Synonymic Cat., 1890.

Ab. male 31, female 32; h. w. male 25, female 26.

Male.—Greenish yellow, marked with dark brown; face and occiput green. Thorax with the following brown: a mid-dorsal stripe slightly wider below, not reaching the anterior edge, above narrowly joined to the antehumeral, an antehumeral and humeral stripe, and the first and second sutures and much of the space between them. Abdomen dark brown, segments 1–8 with a narrow yellow mid-dorsal stripe; sides of 1 and 2 greenish; sides of 8 and 10, and nearly all of 9, yellow. Costa yellowish green.

Female.—Similar. Abdomen with the sides yellower, and 9 and 10 yellow above. Legs paler than in the male. Vulvar lamina short, triangular, the apex bifid, the ends rounded.

Quebec; Maine, New York, Massachusetts, Maryland, New Jersey, Pennsylvania, Florida, Michigan, Ohio, Indiana.

Christiana Creek, May 25, 1897, one female; Simonton Lake, July 1, one female, July 8, 1897, one male, not common; Indiana Lake, June 25, 1899 (Weith); Goose Lake, July 8, 1897, one female (Deam).

G. sp. Collected by Prof. R. C. Osburn, Loudonville, Ohio, June 10, 1899. Pl. VI, fig. 22.

Ab. male 35; h. w. male 28.

Male.—“Abdominal appendages and genitalia like *brevis*, and head of *abbreviatus*”—Calvert.

Thorax bright olive, dark brown as follows: on either side of the mid-dorsal carina, not extending to the anterior edge, an antehumeral and humeral, equal in width and joined above and below, and short lines below on the lateral sutures. Abdomen black, yellow triangular basal spots on 1-7. Occiput high, rounded. Legs black, first femora green below. Segments 7-9 moderately expanded.

New York (Calvert) and Ohio (Osburn).

G. NOTATUS Rambur (*notatus* L., marked). Pl. VI, fig. 23.

G. notatus Rambur, Ins. Névr., p. 162, 1842; Hagen, Syn. Neur. N. A., p. 110, 1861.

G. fluvialis Walsh, Proc. Ac. Phila., p. 394, 1862.

Aeshna notata Kirby, Synonymic Cat., 1890.

Ab. male 40, female 41; h. w. male 32, female 34.

Male.—Greenish yellow and black; vertex and occiput black, frons black with a transverse yellow line (interrupted in the middle) above, clypeus with black on either side of the center, labrum with the lower half, edges, and broad median stripe, black. Thorax black, the following greenish yellow: interrupted mesothoracic semicollar, dorsum each side with a short oblique bar, a narrow, sometimes interrupted, antehumeral stripe, and all of the sides, excepting broad lines on the sutures. Abdomen black, the following greenish or yellow: mid-dorsal line on 1 and 2, indistinct dorsal basal spot on 3 and 8, sometimes appearing also on the other segments, the extreme posterior edge of 8 and 9, sides of 1 and 2 and 8-10. Legs black, anterior femora green beneath.

Female.—Similar, throughout with less black; thoracic antehumeral stripe wider. Abdominal segments 3-8 with small yellow basal spots above. Occiput similar to *plagiatus*. Vulvar lamina short, terminating in two conical, divaricating branches.

Canada; Michigan, Illinois, Ohio.

This species may be looked for along the Ohio and Wabash, and perhaps other larger rivers.

G. AMNICOLA Walsh (*amnicola* L., that grows near a river).

G. amnicola Walsh, Proc. Ac. Phila., p. 396, 1862.

Aeshna amnicola Kirby, Synonymic Cat., 1890.

Ab. male and female 36; h. w. male and female 33.

Male and female.—Similar to *notatus*. Described as brighter yellow; the oblique stripes on the thorax above shorter; the antehumeral line interrupted; and an incomplete line on the first lateral suture, and none on the second. Superior abdominal appendages of the male less divaricate; vulvar lamina of the female ending in two contiguous branches.

Illinois, Iowa.

G. SPINICEPS Walsh (*spina* L., a thorn; *caput* L., the head). Pl. VI, figs. 24 and 25.

Macrogomphus (?) *spiniceps* Walsh, Proc. Ac. Phila., p. 389, 1862.

G. spiniceps Selys, Bull. Ac. Belg. XXV (2), p. 750, 1873.

Aeshna spiniceps Kirby, Synonymic Cat., 1890.

Ab. male 46, female 47; h. w. male 37, female 39

Male and female.—Black, marked with olive and yellow; similar to *notatus*; face without distinct black markings, obscured with brown; oblique bands on dorsum of thorax longer; first and second lateral sutures and the space between them brown; basal yellow spots on 3-7 more conspicuous; occiput of the male almost straight, little elevated; female with a small median notch, similar to *plagiatus*; vertex of the female with a yellow acute spine behind each lateral ocellus; first hamular branch long, exposed part equal to twice the distance from it to the base of the segment, curved; in *notatus* about equal to this distance, and straight; vulvar lamina very short, rounded.

Massachusetts, Illinois, Pennsylvania, Ohio.

On July 4, 1899, large numbers of this species were transforming along the Allegheny River just above Pittsburg in western Pennsylvania. It was impossible to capture the fully matured individuals which occasionally flew up from the grass or from the willow shrubs. The teneral were more often found among the willows than elsewhere.

G. PLAGIATUS Selys (*plagios* Gr., sloping). Pl. VI, figs. 26, 27 and 37.

G. plagiatus Selys, Bull. Ac. Belg. XXI (2), p. 57, 1854; Hagen, Syn. Neur. N. A., p. 109, 1861.

Aeshna plagiata Kirby, Synonymic Cat., 1890.

Ab. male 43, female 45; h. w. male 35, female 37.

Male and female.—Brown or fuscous, marked with yellow or green, duller than the preceding related species, similar. Teneral have the abdomen almost entirely yellow, obscured with pale brown; fully colored individuals have the abdomen brown, with a yellow, mid-dorsal stripe, more conspicuous than in *notatus*, and segments 9 and 10 pale brown. Humeral stripes longer than in *notatus*; antehumeral stripe wider than in *notatus* or *spiniceps*, not interrupted or narrowed above.

Maryland, South Carolina, Pennsylvania, Tennessee, Florida, Texas, Ohio, Illinois (Adams).

This species is common in the great marshes about Sandusky, Ohio. It is easily taken. A male, collected by R. C. Osborn, July 9, 1899, shows a peculiar thoracic color pattern, due to the reduction of the dark markings. The pale oblique bars on each side of the thorax above are widest in front, where they are continuous with the mesothoracic half-collar; the dark humeral and antehumeral stripes are separated by the width of the former; first and second sutures with brown, interrupted on the first, wider on the second. The coloration of other parts of this specimen is as usual.

G. *SEGREGANS* Needham (*segregans* L., living apart).

Stylurus segregans Needham, Can. Ent. XXIX (8), p. 185, 1897.

Ab. male 44; h. w. male 35.

Described from a single male, reared at Havana, Ill. Similar to the preceding species. The appendages are described as follows: "Male superior appendages yellowish brown, much longer than 10, divaricate at almost a right angle, slightly incurved toward the tip and cut obliquely to form an obtuse external angle at two-thirds their length, and a supero-internal point. The bevelled portion is minutely denticulate opposite the apices of the inferior appendage. No teeth or spines. The inferior appendage is bifid half its length with branches strongly divergent and strongly upcurved, their apices resting outside the bevelled portion of the superiors."

DROMOGOMPHUS Selys. (*dromos* Gr., flight; *Gomphus*, a genus of Odonata, *gomphos* Gr., a wedge-shaped bolt).

Selys, Bull. Ac. Belg. XXI (2), p. 58, 1854.

A genus of three known species, confined to North America.

Femora of last pair of legs entirely black. *spinus*.

Femora of last pair of legs with much yellowish. *spoliatus*.

D. *SPINOSUS* Selys. (*spinus* L., thorny). Pl. II.

D. spinus Selys, Bull. Ac. Belg. XXI (2), p. 59, 1854.

Gomphus spinus Hagen, Syn. Neur. N. A., p. 102.

D. spinus Kirby, Synonymic Cat., 1890.

Ab. male 41, female 43; h. w. male 34, female 36.

Male.—Black or brown, marked with yellowish green; face and occiput yellowish, the occiput convex. Thorax above yellowish, this pale area about equaling in width the wide brown humeral stripe, which is divided by a pale, sinuate, narrow, antehumeral stripe; anteriorly the brown

humeral stripe gives off a narrow brown stripe which passes to near the mid-dorsal carina and then backward, disappearing above; sides light colored. Abdomen largely black, with an interrupted longitudinal mid-dorsal stripe, widest anteriorly; 7-9 dilated. Legs black, first femora green beneath. Abdominal appendages black, divaricate, pointed; the inferior shorter than the superiors.

Female.—Similar; the line turning inward and upward from the humeral stripe along the mid-dorsal carina is wider than in the male, so the female seems to have a mesothoracic collar, joined by a mid-dorsal stripe, and short oblique bars on either side of and near the mid-dorsal stripe, yellow. An acute spine behind each lateral ocellus. Occiput with a median acute spine.

Maine, Georgia, Kentucky, West Virginia, Illinois, Texas, New York, Pennsylvania, Massachusetts, New Jersey, Florida, Michigan, Ohio, Indiana.

Elkhart, June 9, 1895; June 10, 1897; June 5, 1899, in woods, rare; Elkhart River, July 4, 1897; Indiana Lake, June 25, 1899, common (Weith); Wabash River, June 22, 1898; St. Mary's River, Ft. Wayne, June 26, 1898, flying over ripples.

“The female has been observed often ovipositing in a manner similar to *Macromia illinoensis*, that is, by skimming the water and every few feet touching it with the abdominal tip, scarcely checking her speed; at other times I have seen them drop from an overhanging tree and repeatedly tap the water, remaining in one place, after the manner of *Libellula*. Pairs were noticed to fly up into tree tops and remain in union for a considerable time.”—(Odonata of Ohio.)

D. *SPOLIATUS* Hagen (*spoliatus* L., impoverished).

Gomphus spoliatus Hagen, Mon. Gomph., p. 409, 1857; Syn. Neur. N. A., p. 103, 1861.

D. spoliatus Kirby, Synonymic Cat., 1890.

Male.—Yellow or greenish yellow, marked with brown; face and occiput greenish. Thorax above brown, a mesothoracic collar, mid-dorsal carina, an oblique bar on either side and a narrow antehumeral stripe, sometimes interrupted, yellow; sides greenish yellow, a brown stripe on each suture. Abdomen with 1-6 above black or dark brown, an irregular, interrupted longitudinal mid-dorsal stripe and sides, yellow; 7-9 greatly dilated, yellow, clouded and shaded more or less with brown; 10 entirely yellow. Pterostigma light brown; costa greenish. Abdominal appendages yellow, in profile straighter than in *D. spinosus*, less curved, and the superiors with the inferior carina less strongly developed.

Female.—Similar. Occiput with an obtuse prominence at the middle. Texas, Ohio.

June and July. This species has been taken along the Maumee River, in northwestern Ohio. It may certainly be expected along the rivers or canal at Ft. Wayne.

OPHIOGOMPHUS Selys. (*ophis* Gr., a serpent; *Gomphus*, a genus of Odonata, *gomphos* Gr., a wedge-shaped bolt).

Selys, Bull. Ac. Belg. XXI (2), p. 39, 1854.

A genus including a dozen species. Two occur in Asia, a third in Europe and the remaining nine are confined to North America. For a discussion of the genus, and figures of the N. A. species, see Needham, Can. Ent. XXXI (9), September 1899, p. 233.

O. RUPINSULENSIS Walsh (*rupes* L., a rock; *insula* L., an island: Rock Island, Illinois).

(*H*) *erpetogomphus* ? *rupinsulensis* Walsh, Proc. Ac. Phila., p. 388, 1862.

O. rupinsulensis Selys, Bull. Ac. Belg. XLVI (2), p. 434, 1878.
Diastatomma rupinsulense Kirby, Synonymic Cat., 1890.

Ab. male 39, female 38; h. w. male 31, female 32.

Male.—Bright green or yellowish green, marked with brown; face, occiput and parts of vertex, green. Thorax with indistinct brown as follows: a humeral line wider above, an antehumeral of equal width, and the upper part of the second lateral suture. Abdomen brown with elongated basal spots, pointed posteriorly, on 1-9, sides of 1 and 2 and 7-9, and most of 10, greenish yellow. Pterostigma brown; costa green or yellow. Legs pale proximally, darker distally. Abdomen slender, 7-9 expanded. Appendages yellow or greenish; superiors obtuse, curved inwards; inferior shorter, its branches not divaricate, before the apex a stout process, pointing upward and outward.

Female.—Similar; brown thoracic marks fainter. Abdomen duller, more robust, 8 and 9 somewhat expanded. Vulvar lamina almost as long as 9, bifid, the branches divergent only at the apex.

Canada; Maine, New York, Illinois, Wisconsin, New Jersey, Pennsylvania, Ohio, Indiana.

Elkhart, May 30, 1895, over marsh; June 17, 1897, and May 11 and 23, 1899, not common, in woods (Weith); Wabash River, June 10, 1898, one male.

May and June, frequenting the ripples of larger streams, flying back and forth over the water or resting on the ground near the water's edge. The size and bright color at once distinguish this species.

CORDULEGASTER Leach (*cordyle* Gr., a club; *gaster* Gr., the abdomen).

Leach, Edinb. Encyc. IX, p. 136, 1815.

A genus of 15 known species, distributed over North and Central America, Europe, Asia and Africa. Three fossil species have been referred to this genus. Two species may be expected in the State. They are rare, apparently frequenting ravines and the edge of woods.

Mr. J. S. Hine has kindly furnished me with the following note: "Professor Kellicott took *C. erroneus*, female, at Sugar Grove, Ohio, resting on a branch above a cold spring on a hill-side. I found *C. obliquus* June 12, 1899, at Medina, Ohio. Between two hills in a pasture the water had formed a small gutter, similar to a furrow, rather crooked. A small amount of water stood in this gutter at intervals. The *Cordulegasters* followed the bends of the gutter very closely, flew leisurely, and did not seem at all molested by my presence. If I had held my net quiet I believe they would have flown in. I never before saw so large a species taken so easily. I took them about ten o'clock in the morning. The strip between the two hills mentioned above was perhaps ten rods wide. The hills on either side were thinly wooded. J. B. Parker took the same species in the ravine north of the township line near Columbus last spring. He said the species seemed to be common and flew rather leisurely. I visited the place a few days later but was unable to procure or even see a single specimen."

Abdominal segments 2-7 with yellow sub-median transverse rings, very narrowly interrupted above on 3-7. *erroneus*.

Abdominal segments 2-8 maculate above with spear-shaped yellow spots. *obliquus*.

C. ERRONEUS Hagen (*erroneus* L., wandering about).

C. erroneus Hagen, Bull. Ac. Belg. XLVI (2), p. 688, 1878; Kirby, Synonymic Cat., 1890.

Ab. male 54, female 55; h. w. male 44, female 50.

Male and female.—Black or brown, marked with yellow; face yellow and black. Thorax with the following yellow; diverging stripes on the dorsum and two broad stripes on either side. Abdomen yellow as follows: a narrow median transverse ring on 2 (in the female this widens on either side, passing forward onto the sides of 1; in the male much of 2 may be yellow, the black confined to a large mid-dorsal spot), wider sub-median transverse rings on 3-7, 8 with two spots on either side, the posterior two indistinct in the female. Male superior abdominal appendages shorter than 10, the apices turned outward, in profile a conspicuous sub-median ventral process; inferiors slightly shorter, broadly bifid at apex. Anterior row of spines on second and third tibiae replaced

by knobs. In the female the vulvar lamina long, projecting, about three times as long as 9.

North Carolina, Kentucky, Pennsylvania, West Virginia, Ohio.

C. OBLIQUUS Say (*obliquus* L., slanting).

Aeshna obliqua Say, Journ. Ac. Phila. VIII, p. 15, 1839.

C. obliquus Hagen, Syn. Neur. N. A., p. 116, 1861.

Ternigaster obliqua Kirby, Synonymic Cat., 1890.

Ab. male 50, female 54; h. w. male 42, female 47.

Male and female.—Similar to the preceding; dorsal thoracic stripes wider and shorter. Abdomen with segments 2-8 (female) or 3-9 (male) each with a mid-dorsal spot, long on 2 and 3, shorter and basal on the remaining segments. In the male the superior abdominal appendages are shorter than 10, apices not turned outwards, in profile with the lower edge straight, without ventral processes; inferior shorter, scarcely bifid.

Canada; Maine, Massachusetts, Illinois, West Virginia, Ohio, Indiana.
"Inhabits Indiana" (Say).

BOYERIA MacLachlan (named for Boyer de Fonscolombe).

MacLachlan, Ann. Mag. Nat. Hist. XVII (6), p. 424, 1896.

New name for *Fonscolombia* Selys.

A genus of three species, found in Europe, Japan and North America.

B. VINOSA Say (*vinosus* L., full of wine).

Aeshna vinosa Say, Journ. Ac. Phila. VIII, p. 13, 1839.

Aeshna quadriguttata Hagen, Syn. Neur. N. A., p. 130, 1861.

Fonscolombia vinosa Kirby, Synonymic Cat., 1890.

Ab. male and female 50; h. w. male 42, female 44.

Male.—Color dark brown, marked with green and yellow; face obscure greenish. Thorax with a dorsal green stripe on either side above and two bright yellow spots on each side below. Abdomen spotted with yellow. Pterostigma yellowish brown; wings brown at base and sometimes faintly at apex. Abdomen constricted at 3, a longitudinal mid-dorsal stripe on 3-8; superior appendages almost as long as 9+10, widest beyond the middle, apex hardly acute, a small ventral tooth near the base; inferior two-fifths as long as superiors, triangular, the apex notched.

Female.—Similar, the green dorsal thoracic stripes obscure. Hind wings with the anal angle rounded, not acute as in the male.

Canada; Maine, New York, Massachusetts, Pennsylvania, Maryland, District of Columbia, Carolina, Georgia, Kentucky, Tennessee, Arkansas, Michigan, Ohio, Illinois (Adams), Indiana.

Elkhart, June 20, 1899, rare, flying in the woods (Weith).

June to September, usually along streams with wooded banks.

BASILESCHNA Selys (*basis* Gr., base; *Aeschna*, a genus of dragonflies, probably *aischros* Gr., ugly).

Selys, Bull. Ac. Belg. V (3), p. 735, 1883.

A genus of a single species.

B. JANATA Say (*Janus* L., a Latin deity).

Aeshna janata Say, Journ. Ac. Phila. VIII, p. 13, 1839.

Aeschna janata Hagen, Syn. Neur. N. A., p. 125, 1861.

B. janata Kirby, Synonymic Cat., 1890.

Ab. male and female 43; h. w. male and female, 36.

Male.—Brown, marked with green and yellow; face greenish, frons with a black T mark above. Thorax with an obscure dorsal green stripe on either side above, and sides each with two yellow stripes, narrowly bordered with black. Abdomen spotted and banded with greenish, fading in dry specimens. Wings yellowish brown at base; anal angle of the hind wings acute. Abdomen constricted at 3. Superior appendages about equal to 9+10, basal three-fifths extending downwards and backwards, apical two-fifths extending directly backwards, expanded, the interior edge straight; inferior equal to one-half the superiors in length, triangular, pointed.

Female.—Similar. Anal angle of hind wings rounded. Appendages simple, straight.

Maine, Massachusetts, New York, New Hampshire, New Jersey, Ohio, Indiana.

Elkhart, May 7, 1896, in the roads; May 4, 1898, April 30, May 4 and 11, 1899, in woods, rare; Christiana Creek, May 5, 1899 (Weith).

April, May and June. This species may often be found flying back and forth over some small stream or pond much after the manner of the *Aeschnas* which appear later in the season.

GOMPLESCHNA Selys (*Gomphus*, a genus of Odonata, p. 283; *Aeschna*, a genus of Odonata, p. 303.)

Selys, Trans. Ent. Soc. Lond., p. 413, 1871.

A genus represented by a single species from the United States. (Calvert—*Cat. Od. Phila.*, 1893, p. 248.)

G. FURCILLATA Say (*furcilla* L., little fork).

Aeshna furcillata Say, Journ. Ac. Phila. VIII, p. 15, 1839.

Aeschna furcillata Hagen, Syn. Neur. N. A., p. 131, 1861.

A. antilope Hagen, Proc. Bost. Soc. Nat. Hist. XVI, p. 354, 1874.

Gomphæschna furcillata and *G. antilope* Kirby, Synonymic Cat., 1890.

Ab. male 43, female 40; h. w. male 35, female 36.

Male.—Brown, marked with blue or green and black; face brown, frons above with a black T spot. Dorsum of the thorax with an obscure green stripe on either side; humeral suture above, first lateral suture below, and second lateral suture for its entire length, narrowly black. Abdomen black or dark brown with yellow or green (brown in dried specimens) markings. Pterostigma brown; costa yellowish. Superior abdominal appendages as long as 9+10, straight, widened for the apical half, apex rounded, an inferior basal tooth; inferior two-fifths as long, bifid at apex, divaricate.

Female.—Similar, front wings with a faint brown spot, sometimes wanting, at the nodus. Appendages as long as 10, straight, simple.

Massachusetts, Vermont, Maryland, Georgia, Michigan, New Jersey, Virginia, Ohio, Pennsylvania (Graf).

May and June. A specimen, a female, given me by Mr. Graf, flew into his home in Pittsburg. The single specimen taken in Ohio, also a female, was found one morning clinging to a screen door in Columbus.

EPLÆSCHNA Selys (*epi* Gr., near; *Aeschna*, a genus of Odonata, p. 303).

Selys, Proc. Bost. Soc. Nat. Hist. XVIII, p. 36, 1875.

A genus including two known species, one from North America, the other from South America. "This horrible creature had no mouth that we could perceive; but, as if to make up for that deficiency, it was provided with at least four score of eyes, that protruded from their sockets like those of the green dragonfly."—*The Thousand and Second Tale*, E. A. Poe.

E. HEROS Fabricius (*heros* Gr., a warrior).

Aeshna heros Fabricius, Ent. Syst. Suppl., p. 185, 1798.

Aeschna heros Hagen, Syn. Neur. N. A., p. 128, 1861.

E. heros Kirby, Synonymic Cat., 1890.

Ab. male 66, female 68; h. w. male 56, female 60.

Male.—Brown, marked with green; face brown and green; frons above with a T spot. Thorax with the following green: a dorsal stripe, wider

above, on either side, and two broad green stripes on each side. Abdomen marked with green rings and spots. The colors fade till the abdomen becomes entirely brown; in life the colors are most beautiful, the eyes deep blue above, shading below into green. Wings usually tinged more or less with yellowish; the apices sometimes brown; pterostigma reddish brown. Abdominal segment 10 with a median dorsal spine. Superior appendages long, apical two-thirds expanded; inferior one-half as long, apex notched.

Female.—Similar. Occiput on either side produced backward in an obtuse angle. Abdominal segment 10 with a ventral denticulate projection. Appendages as long as $9\frac{1}{2}$ + 10, leaf-like, simple.

Quebec to Mexico, west to the Mississippi; Michigan, Ohio, Illinois, Indiana.

"*Aeshna multicolor*.—Inhabits Indiana" (Say); Elkhart, May 24, 1896, one female caught in the house; June 23, 1897, one male (Weith); Bluffton, July, 1896, one female caught in the house by Miss Henrietta Arnold.

Before storms this species often enters houses. It flies from May till September, but is commonest during May and early summer, when it may be expected along country roads, in open woods, over fields or water—any place where it may hunt flying insects.

ÆSCHNA Fabricius ("A name introduced by former writers," probably *aichros* Gr., ugly).

(*Aeshna*) Fabricius, Syst. Ent., p. 424, 1775.

A genus of about 50 species, represented in North and South America, Europe, Asia, Africa and Australia. Eleven fossil species have been referred to this genus. Three species have been taken in Indiana and a fourth may be expected. The three known to occur in the State are very similar in habits. They frequent the edges of woods, especially where there are pools of water or some small stream, from the last of July until late in the fall. During the middle of the day they spend much of the time resting on twigs of bushes and trees. Late in the afternoon they are most active, flying about over fields, and hovering over stretches of water. They constantly return to some sheltered nook among the bushes or sedges to catch the insects there. As darkness comes on, they are seen to take long rests in clumps of weeds and grass or in trees, and finally they cease flying altogether.

Frons above with a black T spot. 1.

Frons above without a black T spot. *pentacantha*.

1. Male.—Anal triangle of hind wings of 2 cells; 10 with three dorsal basal spines, the median one the largest. 2.

Male.—Anal triangle of hind wings of 3 cells; 10 without dorsal spines. *constricta*.

2. Superior longitudinal carina of the superior appendages not denticulate. *verticalis*.

Superior longitudinal carina of the superior appendages with 4-9 denticles. *clepsydra*.

A. VERTICALIS Hagen (*vertex* L., the highest point). Pl. VII, figs. 10 and 11.

A. verticalis Hagen, Syn. Neur. N. A., p. 122, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 52, female 53; h. w. male 45, female 46.

Male.—Reddish brown; marked with green and blue. Thorax with a green stripe, wider above, on either side above; sometimes a short green antehumeral stripe, and two stripes on either side, the anterior one most distinct, green or blue. Abdomen with spots and rings of green and blue. Abdomen slenderer than in *constricta*; constricted at 3. Superior appendages as long as 9+10.

Female.—Similar. Hine states that this species may be recognized from *constricta* by the length of the vulvular process, 2 mm. in *constricta*, 1 mm. in *verticalis*. The appendages are also only about half as wide as in that species.

Nova Scotia to the District of Columbia; Illinois, California, Ohio, Indiana.

Elkhart, September 9, 1895, one female, probably this species, taken in a grove (Weith).

A. CLEPSYDRA Say (*clepsydra* Gr., a water-clock). Pl. VII, figs. 12 and 13.

Aeshna clepsydra Say, Journ. Ac. Phila. VIII, p. 12, 1839.

Aeshna clepsydra Hagen, Syn. Neur. N. A., p. 122, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 54, female 52; h. w. male 46, female 44.

Male and female.—Coloration similar to the preceding. Male distinguished by the denticles on the superior carina of the superior abdominal appendages; female not separable.

Finland, Siberia, Canada; Labrador to Massachusetts; New York, Maryland, Michigan, Wisconsin, Illinois, Dakota, Ohio, Indiana.

Turkey Lake, two males and one female (Kellicott).

A. **CONSTRICTA** Say (*constrictus* L., constricted). Pl. IV, fig. 10; pl. VII, figs. 14 and 15.

Aeshna constricta Say, Journ. Ac. Phila. VIII, p. 11, 1839.

Aeschna constricta Hagen, Syn. Neur. N. A., p. 123, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 55, female 54; h. w. male and female 45.

Male.—Reddish brown, marked with bright green; face green or brown. Thorax with a broad green stripe on either side above, a short green antehumeral stripe, and two stripes on either side green or blue. Abdomen marked with green and blue spots and rings, constricted at 3. Superior appendages slightly longer than 9+10.

Female.—Similar. Wings often tinged with yellowish. Appendages simple.

Siberia; Labrador to Maryland, west to Colorado; British Columbia to Lower California; Ohio, Illinois, Indiana.

“Inhabits Indiana” (Say); Lake, Jackson Township, Wells County, September 14, 1899, common (Deam); Elkhart, October 12, 1899 (Weith); Round Lake, September 2, 1897, numerous about the outlet of the lake, pairing at rest on weeds and low shrubs.

This and *Anax junius* are the common representatives of the subfamily in the State. The males of *constricta* have the abdomen marked with blue, with little or no green, while the females have but little blue or none at all. This is true also of *verticalis* and *clepsydra*.

A. **PENTACANTHA** Rambur (*pente* Gr., five; *acantha* Gr., a thorn).

A. pentacantha Rambur, Ins. Névr., p. 208, 1842; Hagen, Syn. Neur. N. A., p. 129, 1861; Kirby, Synonymic Cat., 1890.

Ab. male and female 56; h. w. male and female 48.

Male and female.—Distinguished from the preceding by the absence of a T spot on the frons above. Superior abdominal appendages of the male short, dilated beneath before the apex, obliquely truncated; the inferior a little shorter, obtuse. Female appendages small.

Illinois, Louisiana, Texas.

ANAX Leach (*anax* Gr., a king, a lord.)

Leach, Edinb. Encyc. IX, p. 137, 1815.

A genus of 25 living species, represented in North and South America, Europe, Asia, Africa, and the Hawaiian Islands. One fossil species is known.

Frons above with a black or brown spot. *junius*.

Frons above without markings. *longipes*.

A. JUNIUS Drury (*Junius* L., a proper name).

Libellula junia Drury, Ill. Exot. Ent. I, p. 112, 1770.

A. junius Hagen, Syn. Neur. N. A., p. 118, 1861; Kirby Synonymic Cat., 1890.

Ab. male 55, female 54; h. w. male 51, female 52.

Male.—Green, marked with blue and brown; face green; frons above with a dark spot, surrounded by yellow, the latter surrounded by a blue ring. Thorax green. Abdomen with 1 and base of 2 green; 3–10 bright blue with a longitudinal interrupted mid dorsal brown band. Wings more or less tinged with yellowish. Abdomen constricted at 3. Superior appendages as long as 9–10, with a lateral and posterior sub-apical spine; inferior shorter, quadrangular.

Female.—Similar. Abdomen with the blue of the male replaced by purplish brown. Occiput emarginate. Abdomen less constricted at 3. Appendages leaf-like.

China, Siberia; Quebec to Florida and the West Indies, west to the Pacific; Alaska to Costa Rica; Sandwich Islands; Michigan, Ohio, Illinois, Indiana.

Turkey Lake (Kellicott); Elkhart, over marsh, August 30 and September 3, 1895; September 15 and 18, 1896; April 22, 1898 (Weith); Lake, Jackson Township, Wells County, September 14, 1899 (Deam); Round and Shriner Lakes, August 1, 1896; September 2, 1897; June 7 and 24 and July 21, 1898; Wells County, July and August, 1896; June 22, 1898.

March to November. Occasionally this species will appear in large compact flocks which pass back and forth in pursuit of insects, very much after the manner of night hawks. Like this bird, too, as twilight comes on they fly nearer and nearer the ground as the flocks of small diptera settle to the earth. During the latter part of July, 1896, several such flocks were seen near Bluffton. Some of these flocks numbered at least several hundred individuals. *Junius* is oftenest found during May and June, when they may be found pairing and ovipositing about every weedy pond. They fly about in couple, then drop down on some bit of floating stuff, where they rest a moment or so, the female with her abdomen submerged as she deposits her eggs; then the pair rise and fly back and forth along the shores or over the water, coming to rest again near or at a distance from their former resting place.

A. LONGIPES Hagen (*longus* L., long; *pes* L., foot).

A. longipes Hagen, Syn. Neur. N. A., p. 118, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 56, female 57; h. w. male 52, female 54.

Male.—Head, thorax and base of abdomen, green. Abdomen brick red.

Female.—Abdomen, from the third segment, brown.

Brazil, Mexico, West Indies; New York, Massachusetts, New Jersey, Maryland, Georgia, Florida, Ohio (?).

DIDYMOPS Rambur (*didymos* Gr., double; *ops* Gr., eye).

Rambur, Ins. Névr., p. 142, 1842.

A genus of one species, confined to the United States. The single representative may be found from April till in June patrolling the sunny edges of woods, the shores of lakes, and the banks of rivers.

D. TRANSVERSA Say (*transversus* L., transverse). Pl. IV, fig. 5.

Libellula transversa Say, Journ. Ac. Phila. VIII, p. 19, 1839.

D. transversa Hagen, Syn. Neur. N. A., p. 135, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 37, female 39; h. w. male 34, female 38.

Male.—Gray or brown marked with pale yellow; face brown with a greenish transverse stripe; frons with a black T spot. Thorax with the sides each with a yellow band, bordered in front and behind with black, between the wings. Abdomen above with yellow basal spots; 10 almost entirely yellow. Wings brownish at base. Legs long, slender. Abdomen with 7-9 enlarged. Appendages yellow, longer than 10; superiors incurved, minutely denticulate below; inferior of equal length, triangular.

Female.—Similar. Wings with more brown at the base. Occiput inflated. Abdomen of uniform size throughout. Appendages shorter, straight, simple.

Quebec; Maine, New York, Massachusetts, Vermont, Pennsylvania, District of Columbia, South Carolina, Georgia, Kentucky, Michigan, New Jersey, Texas, Ohio, Indiana.

Shriner Lake, June 7, 1898, one male flying in company with *Gomphus spicatus* and one female taken in an orchard near the lake.

MACROMIA Rambur (*macros* Gr., great, long; *omos* Gr., equally).

Rambur, Ins. Névr., p. 137, 1842.

As defined by Selys, a genus of about 15 species, represented in North America, Europe and Africa. The genus *Epophthalmia* Burmeister, as used by Selys, contains eight or nine species, two of which (*terniolata* and *georgina*) are North American, and, as pointed out by Calvert, are congeneric with *Macromia illinoensis*. *Macromia* Rambur (*pars*) and *Epophthalmia* Burmeister (*pars*) were separated (Selys, 1871) by the following points:

Macromia.—Triangle and internal triangle usually free (the triangle of all the wings and the internal triangle of the front wings sometimes crossed); the exterior side of the triangle of the hind wings straight.

Epophthalmia.—Triangle of all the wings and internal triangle of the front wings crossed; the exterior side of the triangle of the hind wings concave. This genus (minus the first group (*E. tenuolata*) of Selys) contains seven species, found in Asia and the Malay Archipelago.

Thorax above with a yellow stripe on each side; frons above not steel blue. 1.

Thorax above without a yellow stripe on each side; frons above steel blue. *illinoensis*.

1. Abdomen about 60 in length; yellow antehumeral stripe short. *tenuolata*.

Size smaller. 2.

2. Abdomen about 52. *annulata*.

Abdomen about 46. *pacifica*.

M. ILLINOIENSIS Walsh.

M. illinoensis Walsh, Proc. Ac. Phila., p. 397, 1862; Kirby, Synonymic Cat., 1890.

Ab. male 48, female 50; h. w. male 44, female 46.

Male.—Brown and metallic green, marked with pale yellow; face brown, a transverse obscure yellowish band. Sides of the thorax, between the wings, with a yellow stripe. Abdomen black, more or less spotted with yellow, a conspicuous basal spot on 7. Wings very slightly brownish at base, apex often brown. Superior abdominal appendages a little longer than 10, lyre-shaped when seen from above; inferior equal in length to the superiors, triangular, curved upwards.

Female.—Similar; more brown at base of wings and abdomen with more yellow.

Canada; New Hampshire, Massachusetts, Pennsylvania, Tennessee, Illinois, Georgia, Michigan, Ohio, Indiana.

Elkhart, June 11, one male, July 4, one female, 1896; June 15, 1898, one female caught in the house (Weith).

June and July. This species frequents rapid rivers. As it flies along, skirting the banks of the streams, it may be recognized by the basal yellow spot on abdominal segment 7 and by the bright blue and metallic green of the eyes and thorax. R. C. Osborn says that at Sandusky, Ohio, this species may often be found congregated in great numbers in quiet nooks among the bushes near the marshes. They rest on the under side of twigs with the abdomen hanging down, and several individuals may occupy the same twig.

M. TÆNIOLATA Rambur (*tæniola* L., a little band, a ribbon).

M. tæniolata Rambur, Ins. Névr., p. 139, 1842; Hagen, Syn. Neur. N. A., p. 132, 1861.

Epopthalmia tæniolata, Kirby, Synonymic Cat., 1890.

Ab. male 60, female 62; h. w. male 54, female 58.

Male.—Brown and metallic green, marked with yellow; face brown, a transverse yellow nasal band. Thorax with a short yellow stripe on the dorsum near the anterior edge and a broad yellow stripe entirely encircling the thorax between the front and hind wings. Abdomen with an interrupted transverse ring on 2, and a divided spot on the dorsum of 2-8, larger and usually united on 7, yellow. Wings sometimes more or less tinged with yellowish. Abdominal appendages much as in *M. illinoiensis*.

Female.—Similar; often lacking the yellow spots on abdominal segment 8. Wings more yellowish.

Pennsylvania, Maryland, Georgia, Florida, Ohio, Illinois (Adams), Indiana.

Elkhart, May 31, 1896, one female, in thick woods (Weith).

This species is said to resemble *M. illinoiensis* in its habits.

M. ANNULATA Hagen (*annulatus* L., with a ring).

M. annulata Hagen, Syn. Neur. N. A., p. 133, 1861; Kirby, Synonymic Cat., 1890.

Ab. male and female 52; h. w. male 45, female 47.

Similar to the following.

Illinois, Texas.

M. PACIFICA Hagen (*pacificus* L., pacific—Pacific Ocean).

M. pacifica Hagen, Syn. Neur. N. A., p. 134, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 47, female 45; h. w. male 40, female 45.

Male.—Steel blue, marked with yellow; the dorsal thoracic stripes reaching above almost to the yellow stripe on the antealar sinus. Superior appendages a little larger than 10, an external median tooth; the inferior of about equal length, triangular.

Female.—Appendages shorter than 10.

This species is distinguished from *annulata* by its smaller size, labrum narrowly bordered with fuscous, and the frons in front brown.

Texas, California, Illinois (Adams).

EPICORDULIA Selys (*epi* Gr., near to; *Cordulia*, a genus of dragonflies, *cordyle* Gr., a club).

Selys, Bull. Ac. Belg. XXX (2), p. 259, 1871.

A genus confined to the United States, represented by two species.

E. PRINCEPS Hagen (*princeps* L., a chief).

Epithea princeps Hagen, Syn. Neur. N. A., p. 134, 1861.

Epicordulia princeps Kirby, Synonymic Cat., 1890.

Ab. male 43, female 46; h. w. male 41, female 44.

Male.—Olive or yellowish brown, obscurely marked with yellow. Thorax clothed with gray pile; markings obscure. Abdomen with yellow on the sides. Wings with a basal, a nodal (this sometimes wanting) and an apical spot, all variable in size, brown. Superior abdominal appendages almost as long as 9+10, apical two-thirds expanded; inferior less than one-third shorter, long, triangular, the apex with two upturned points.

Female.—Similar. Appendages as long as 9+10. Vulvar lamina almost as long as 9, bifid for its entire length, forcipate.

Canada; Connecticut, New York, Pennsylvania, Maryland, Georgia, Michigan, Illinois, Texas, Ohio, Indiana.

Round and Shriner Lakes, June 7 and 24, and July 21, 1898, common, patrolling the margins of the lakes, difficult to capture; Frantz fish-pond, July 4, 1898, common.

May and June. A strong, restless species frequenting bodies of still water. The wing spots vary greatly in size in different individuals, but they will always distinguish the species in the field.

TETRAGONEURIA Hagen (*tetragonus* Gr., with four equal angles; *neuron* Gr., a nerve).

Hagen, Syn. Neur. N. A., p. 140, 1861.

A genus of eight or nine species, confined to North America. Concerning *T. semiaquea* Burmeister, Calvert (Phila. Cat.) says: "Probably only a variety of *cynosura*." Morse (Psyche, March, 1895) says, after describing the wing markings of *cynosura* and *semiaquea*, "These two forms are doubtless one species, no structural differences being perceptible. There is another species found in the southern States having the fuscous of a more reddish hue, and even wider in extent, which presents differences in the abdominal appendages. This is perhaps the true *semiaquea*." I have males taken in Whitley County, which are *semiaquea*; males taken in Westmoreland County, Pa., which are *cynosura*; and males taken in Fairfield County, Ohio, which are intermediate in the

PLATES FOR PAPER
ON
DRAGONFLIES OF INDIANA.

PLATE I.

FRONT WING OF A SPECIES OF AGRIONIDÆ, *Enallagma civile*.

1. Costa.
2. Subcosta.
3. Median vein.
4. Submedian vein.
5. Postcosta.
6. Principal sector.
7. Ultra-nodal sector.
8. Nodal sector.
9. Subnodal sector.
10. Median sector.
11. Short sector.
12. Upper sector of the triangle.
13. Lower sector of the triangle.
14. Arculus.
15. Antecubitals, two, the first and second, numbering from the base of the wing towards the apex.
16. Postcubitals, ten in number. The ante- and postcubitals in the row of cells just posterior to the costa are known as the ante- and postcubitals of the first series; and those in the second row of cells from the costa are known as the ante- and postcubitals of the second series.
17. Nodus.
18. Basal postcostal vein.
 - A. Pterostigma.
 - B. Basilar space.
 - C. Quadrilateral.
 - G. Antenodal cells.

The points to be especially noticed are the origin of the subnodal and median sectors nearer the nodus than the arculus, and the origin of the nodal sector at the fifth postcubital.

For a fuller account of this subject see *The Wings of Insects*, by Professors Comstock and Needham, in the *American Naturalist*, 1898, especially for the months of January, February, April, October and December.

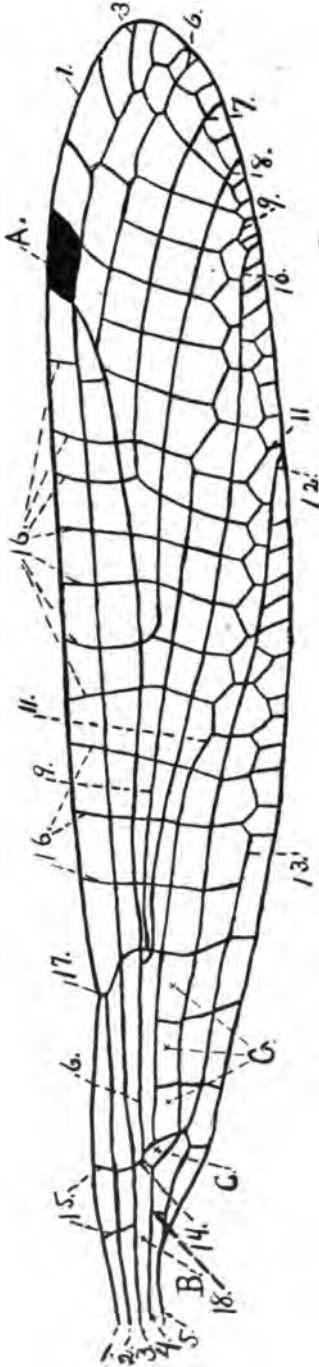


PLATE II.

FRONT WING OF A SPECIES OF AESCHNIDÆ, *Dromogomphus spinosus*.

1. Costa.
2. Subcosta.
3. Median vein.
4. Submedian vein.
5. Postcosta.
6. Principal sector.
8. Nodal sector.
9. Subnodal sector.
10. Median sector.
11. Short sector.
12. Upper sector of the triangle.
13. Lower sector of the triangle.
14. Arculus.
15. Antecubitals, fifteen in the first series, fourteen in the second, the first and fourth of the first series coincident with the first and fourth of the second series.
16. Postcubitals, eleven in both first and second series.
17. Nodus.
 - A. Pterostigma.
 - B. Basilar space.
 - C. Supra-triangular space.
 - D. Median space.
 - E. Internal triangle.
 - F. Triangle.
 - G. Post-triangular cells, three, followed by two rows increasing.

The points to be noticed are the antecubitals of the first and second series not corresponding; the sectors of the arculus (the two veins arising from the apical side of the arculus) separate at their origin; basilar and supra-triangular spaces free (without cross-veins); triangle free; and the presence of an internal triangle.

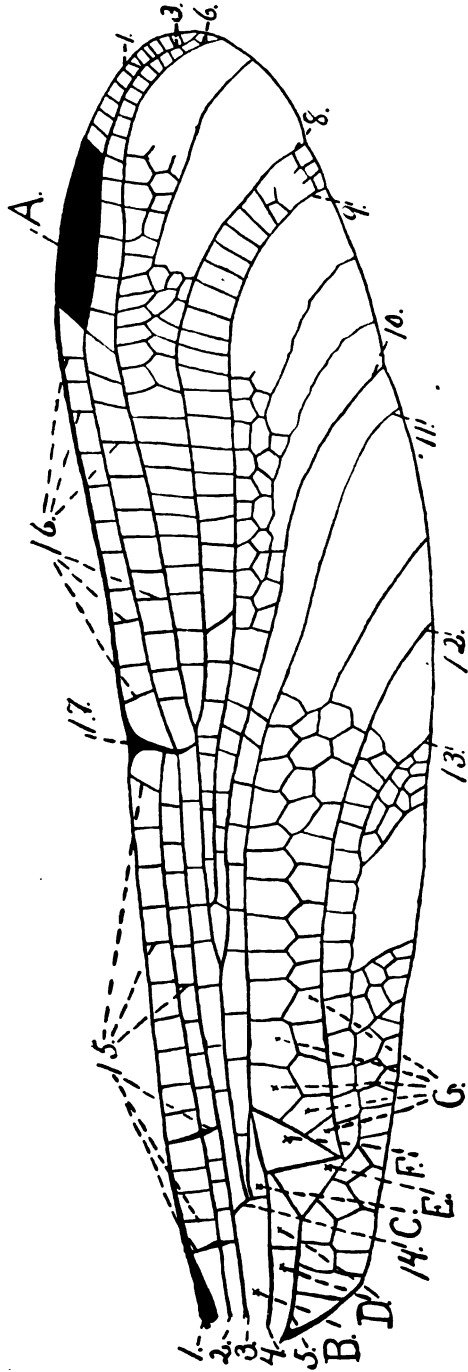


PLATE III.

FRONT WING OF A SPECIES OF LIBELLULIDÆ, *Libellula incesta*.

1. Costa.
2. Subcosta.
3. Median vein.
4. Submedian vein.
5. Postcosta.
6. Principal sector.
8. Nodal sector.
9. Subnodal sector.
- 9a. Supplementary sector between the subnodal and medial sectors.
10. Median sector.
11. Short sector.
12. Upper sector of the triangle.
13. Lower sector of the triangle.
14. Arculus.
15. Antecubitals, sixteen in number, those of the first series coincident with those of the second series, excepting the two nearest the nodus.
16. Postcubitals, twelve in the first series, eight in the second.
17. Nodus.
 - A. Pterostigma.
 - B. Basilar space.
 - C. Supra-triangular space.
 - D. Median space.
 - E. Internal triangle.
 - F. Triangle.
 - G. Post-triangular cells, four, followed by three rows increasing.

In this wing the antecubitals of the first and second series correspond; sectors of the arculus joined at their origin; basilar space free; supra-triangular space with a cross-vein; and triangle once crossed.

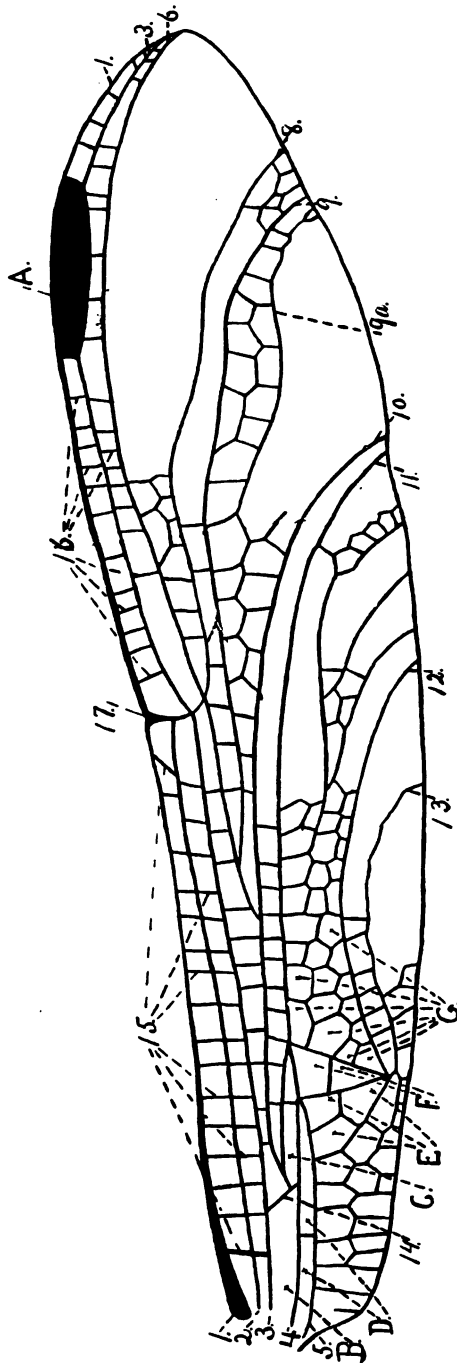


PLATE IV.

Fig. 1. *Libellula incesta*. *a*. Head. *b*. Thorax. *c*. Abdomen, composed of ten segments, I-X. *d*. Frontal vesicle. *e*. Antenna. *f*, *ff* and *fff*. First, second and third legs. *g* and *gg*. Front and hind wings. *h*. Membranule. *i*. Superior appendages.

Fig. 2. Anterior face of the left front leg of *Argia putrida*. *a*. Coxa. *b*. Trochanter. *c*. Femur. *d*. Tibia. *e*. Tarsus, three jointed, showing toothed tarsal claws.

Fig. 3. Anterior view of the head of *Progomphus obscurus*, male. *a*. Eye. *b*. occiput. *c*. Vertex or frontal vesicle. *d*. Frons, bent to form a vertical and a horizontal surface. *e* and *f*. Clypeus or epistoma; *e*, post-clypeus or nasus; *f*, ante-clypeus or rhinarium. *g*. Labrum. *h*. Mandible. *i*. Gena. *j*. Ocelli. *k*. Antenna.

Fig. 4. Ventral view of the head of *Progomphus obscurus*, male. *a*. Eye. *b*. Rear of head. *c*. First maxilla. *d*. Middle lobe of labium or second maxilla. *dd*. Lateral lobe of labium. *e*. Post-clypeus. *f*. Ante-clypeus. *g*. Labrum. *h*. Mandible. *i*. Gena.

Fig. 5. Lateral view of the head of *Didymops transversa*, to show the tubercled eye. *a*. Eye. *b*. Tubercle. *c*. Vertex. *d*. Frons. *e*. Clypeus. *f*. Labrum. *g*. Labium.

Fig. 6. Lateral view of the thorax of *Ischnura verticalis*, showing the three segments which compose the thorax—the prothorax, the mesothorax and the metathorax. *a*. First coxa, borne by the prothorax. *aa*. Second coxa, borne by the mesothorax. *aaa*. Third coxa, borne by the metathorax. *b*. Base of front wing, borne by the mesothorax. *bb*. Base of hind wing, borne by the metathorax. *c*. Pronotum, with its three lobes, the anterior, the middle, and the posterior. *d*. Propleuron. *e*. Articulating surface for the head. *f*. Mid-dorsal carina. *g*. Mesepisternum. *h*. Mesepimeron. *i*. Mesinfraepisternum. *j*. Humeral suture. *k*. First lateral suture. *l*. Metepisternum. *m*. Metepimeron. *n*. Metinfraepisternum. *o*. Second lateral suture. *p*. Metasternum. I and II. First and second abdominal segments.

Fig. 7. Lateral view of abdominal segments 8, 9 and 10 of *Ischnura verticalis*, female. *a*. Ventral apical spine on 8. *b*. Genital valve.

Fig. 8. Tip of left front wing of *Anomalagrion hastatum*, male, showing the unusual position of the pterostigma, *a*.

Fig. 9. Nymph of *Ischnura verticalis*, typical of the suborder *Zygoptera*.

Fig. 10. Nymph of *Aeschna constricta*, typical of the suborder *Anisoptera*.

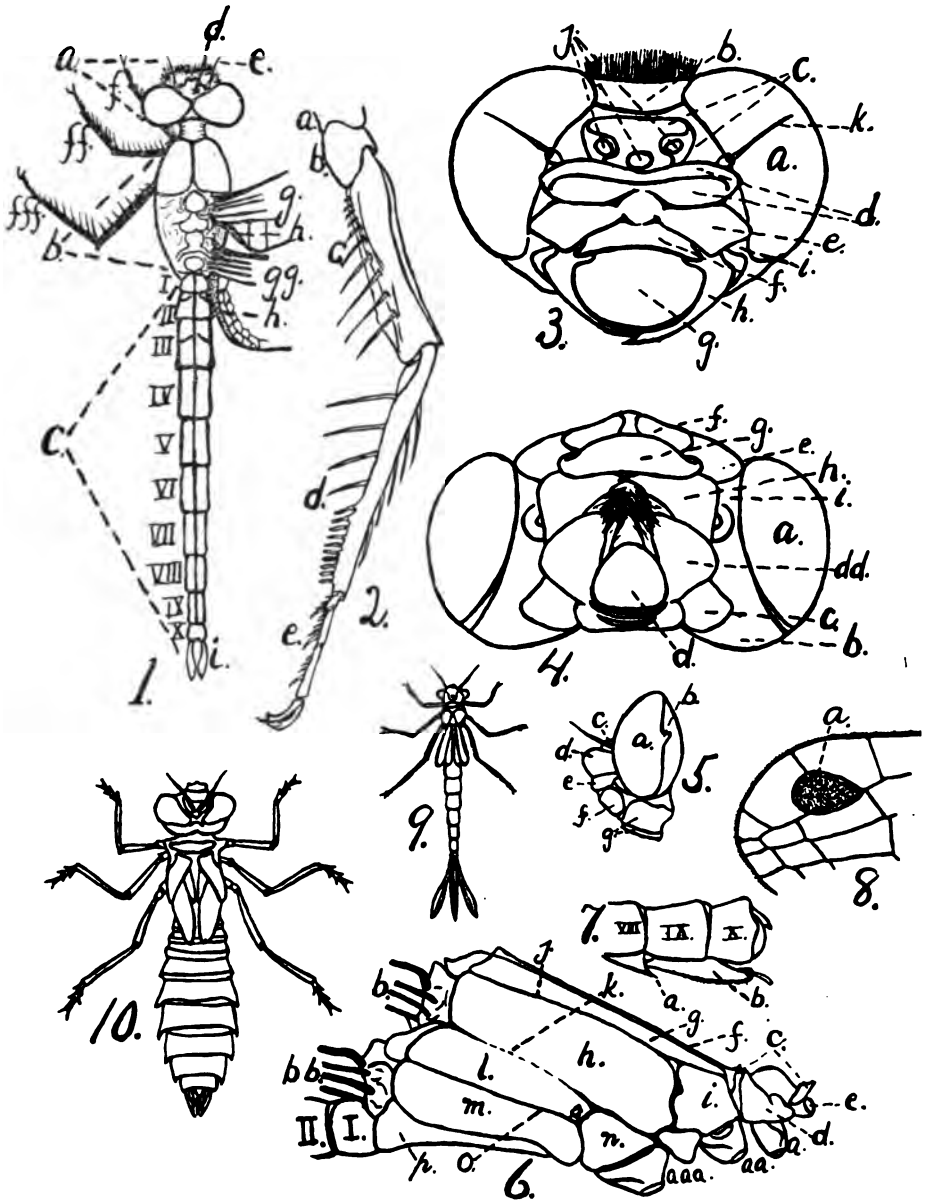


PLATE V.

LATERAL AND DORSAL VIEWS OF THE MALE ABDOMINAL APPENDAGES OF THE
SPECIES OF *Enallagma* TAKEN IN INDIANA.

- | | |
|--------------------------------|---------------------------------|
| 1, 2. <i>E. hageni</i> . | 13, 14. <i>E. piscinarium</i> . |
| 3, 4. <i>E. ebrium</i> . | 15, 16. <i>E. divagans</i> . |
| 5, 6. <i>E. civile</i> . | 17, 18. <i>E. exsulans</i> . |
| 7, 8. <i>E. carunculatum</i> . | 19, 20. <i>E. antennatum</i> . |
| 9, 10. <i>E. traviatum</i> . | 21, 22. <i>E. signatum</i> . |
| 11, 12. <i>E. geminatum</i> . | 23, 24. <i>E. pollutum</i> . |

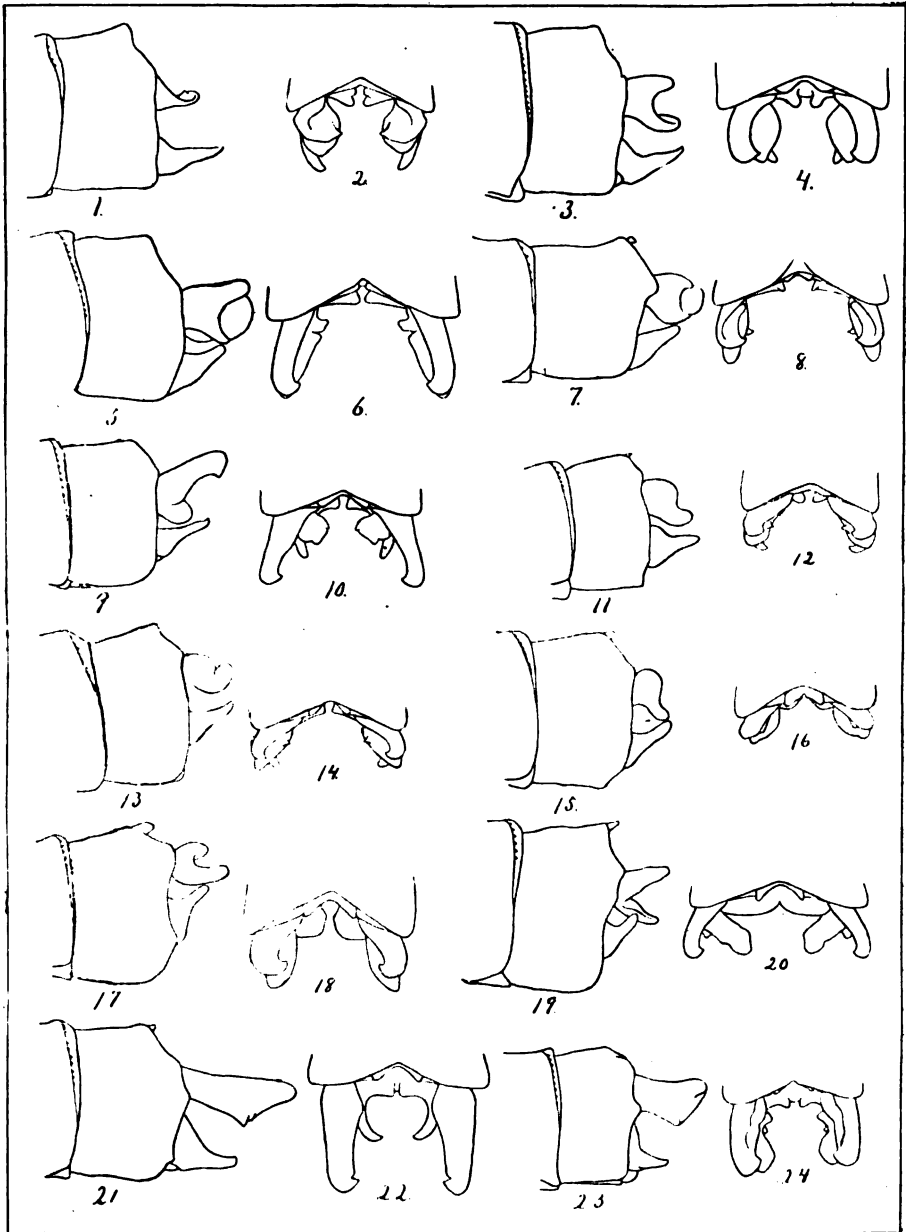


PLATE VI.

GOMPHUS.

- 1, 2, 3, 4. Outlines to show the thoracic markings in the genus.
- | | |
|--------------------------|-----------------------------|
| 1. <i>G. villosipes.</i> | a. Median dorsal stripes. |
| 2. <i>G. externus.</i> | b. Antehumeral stripe. |
| 3. <i>G. vastus.</i> | c. Humeral stripe. |
| 4. <i>G. spiniceps.</i> | d. Lateral stripes. |
| | e. Mesothoracic halfcollar. |

Male abdominal appendages:

- | | |
|---|---|
| 5. Profile of <i>G. vastus.</i> | 17. Profile of <i>G. sordidus.</i> |
| 6. Profile of <i>G. dilatatus.</i> | 18. Profile of <i>G. spicatus.</i> |
| 7. Profile of <i>G. quadricolor.</i> | 19. Profile of <i>G. descriptus.</i> |
| 8, 9. Profile and dorsal of <i>G. fraternus.</i> | 20, 21. Profile and dorsal of <i>G. exilis.</i> |
| 10. Profile of <i>G. externus.</i> | 22. Profile of <i>G. sp.</i> , collected by R. C. Osburn in Ohio. |
| 11, 12. Profile and dorsal of <i>G. grastinellus.</i> | 23. Profile of <i>G. notatus.</i> |
| 13. Profile of <i>G. pallidus.</i> | 24, 25. Profile and dorsal of <i>G. spiniceps.</i> |
| 14. Profile of <i>G. villosipes.</i> | 26, 27. Profile and dorsal of <i>G. plagiatus.</i> |
| 15, 16. Profile and dorsal of <i>G. furcifer.</i> | |

Occipita of females.

- | | |
|-----------------------------|---------------------------|
| 28. <i>G. vastus.</i> | 33. <i>G. villosipes.</i> |
| 29. <i>G. quadricolor.</i> | 34. <i>G. sordidus.</i> |
| 30. <i>G. fraternus.</i> | 35. <i>G. spicatus.</i> |
| 31. <i>G. externus.</i> | 36. <i>G. exilis.</i> |
| 32. <i>G. grastinellus.</i> | 37. <i>G. plagiatus.</i> |

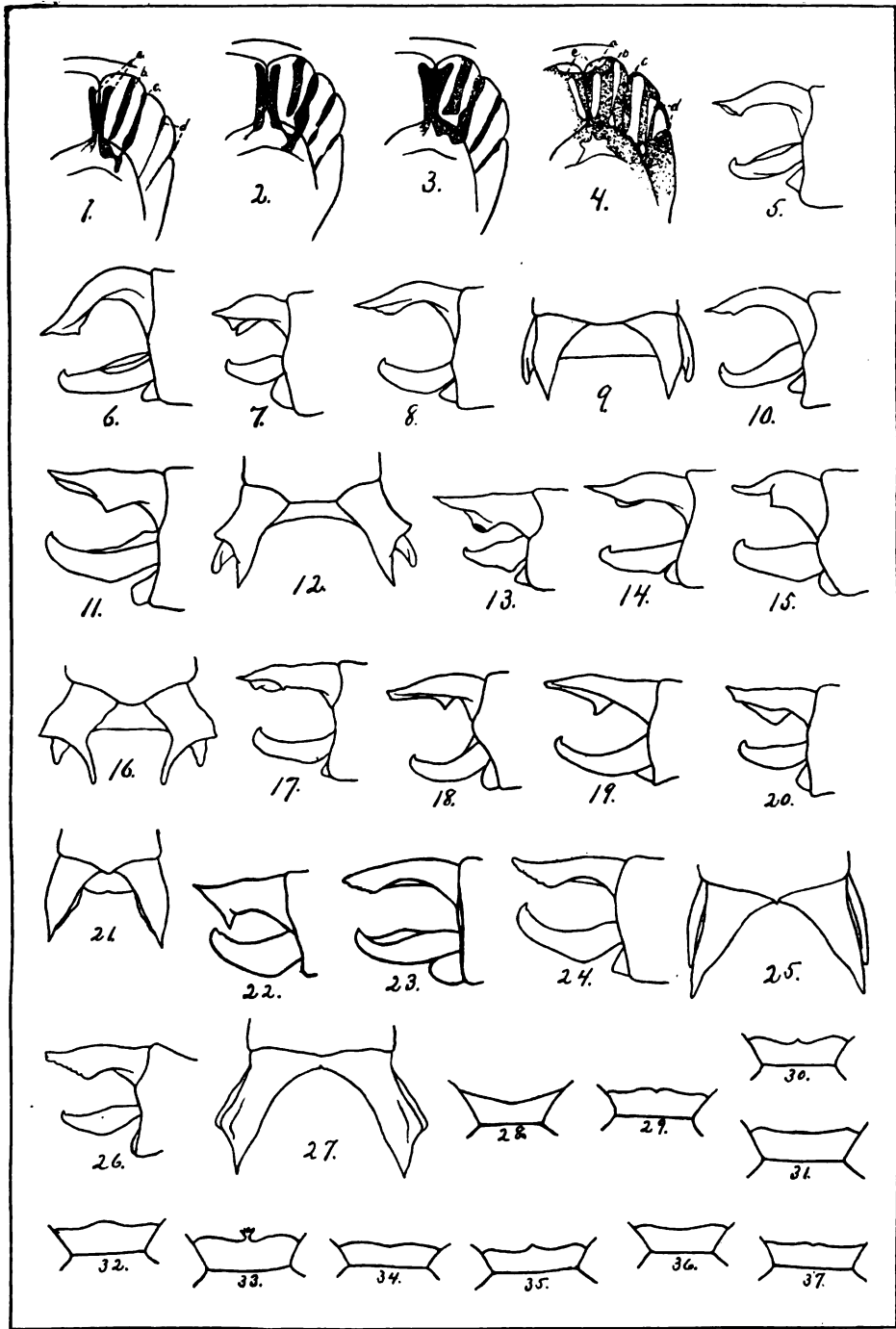


PLATE VII.

Dorsal view of the male abdominal appendages of :

- | | |
|---------------------------------|----------------------------------|
| 1. <i>Lestes unguiculatus</i> . | 4. <i>Lestes vigilax</i> . |
| 2. <i>Lestes uncatus</i> . | 5. <i>Lestes rectangularis</i> . |
| 3. <i>Lestes forcipatus</i> . | 6. <i>Lestes inequalis</i> . |

Lateral view of the male abdominal appendages of :

- | | |
|----------------------------|----------------------------|
| 7. <i>Argia putrida</i> . | 9. <i>Argia apicalis</i> . |
| 8. <i>Argia tibialis</i> . | |

Lateral and dorsal views of the male abdominal appendages of :

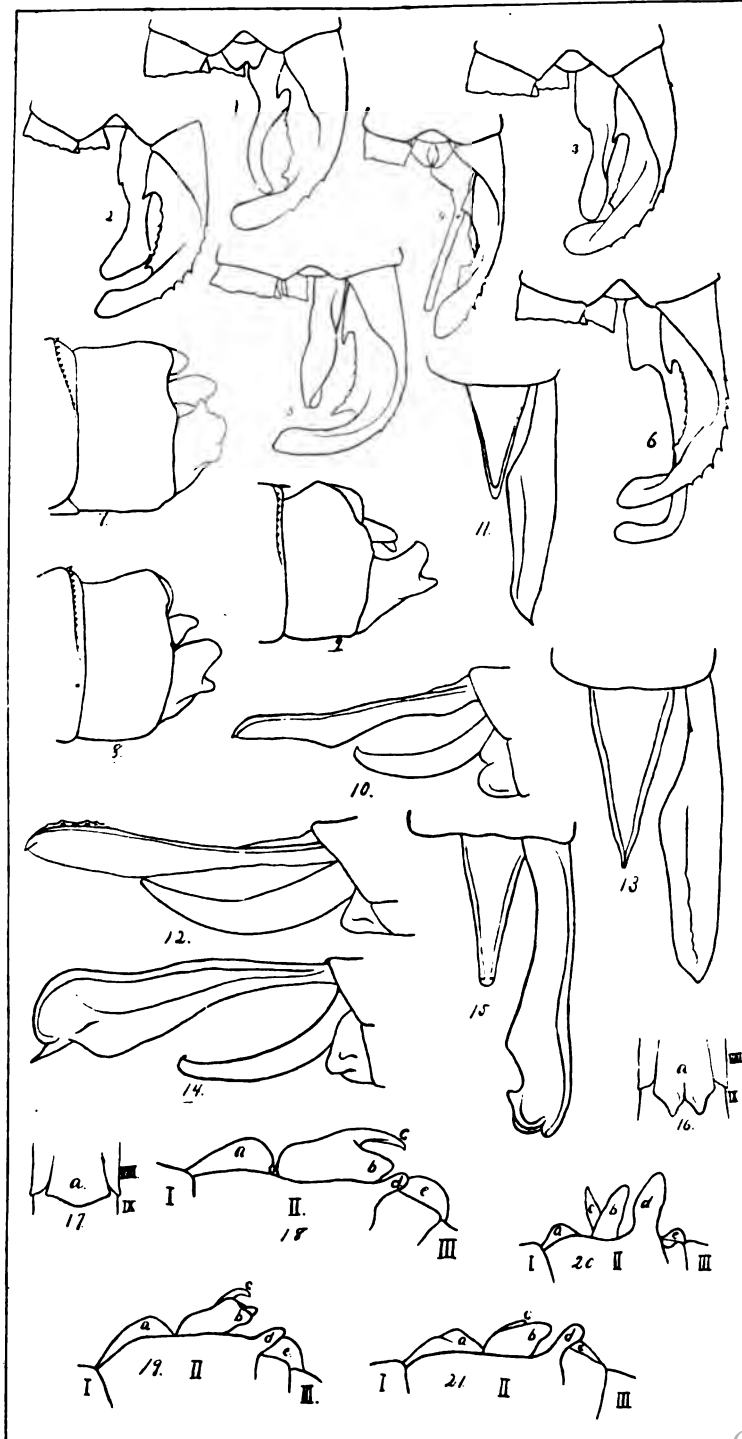
- | | |
|-------------------------------------|-------------------------------------|
| 10, 11. <i>Aeschna verticalis</i> . | 14, 15. <i>Aeschna constricta</i> . |
| 12, 13. <i>Aeschna clepsydra</i> . | |

Vulvar lamina (a) of :

- | | |
|-------------------------------------|--------------------------------|
| 16. <i>Sympetrum rubicundulum</i> . | 17. <i>Sympetrum vicinum</i> . |
|-------------------------------------|--------------------------------|

External male genital organs on the ventral surface of 2. I, II, III, the first three abdominal segments. a. Anterior lamina. b. External hamular branch. c. Internal hamular branch. d. Genital lobe. e. Vesicle.

- | | |
|-------------------------------------|----------------------------------|
| 18. <i>Sympetrum rubicundulum</i> . | 20. <i>Sympetrum vicinum</i> . |
| 19. <i>Sympetrum obtrusum</i> . | 21. <i>Sympetrum corruptum</i> . |





extent of wing coloring. Mr. Adams reports *cynosura* for Illinois. Kellicott and Hine record both *cynosura* and *semiaquea* for Ohio.

A small brown area at base of front wings between the sub-costal and median; male superior appendages with a distinct ventral spine. *spinigera*.

Front wings without the brown area; male superior appendages with a distinct ventral angle only. *cynosura*.

T. SPINIGERA Selys (*spinus* L., a thorn; *gero* L., to bear).

Cordulia spinigera Selys, Bull. Ac. Belg. XXXI (2), p. 269, 1871.

Tetragoneuria spinigera Kirby, Synonymic Cat., 1890.

Ab. male 31, female 32; h. w. male 31, female 33.

Male and female.—Differs from the next species as indicated. Frons above with a black T spot, indistinct in the female.

Canada, Vancouver; Michigan, Georgia.

T. CYNOSURA Say (*cyon* Gr., dog; *oura* Gr., tail).

Libellula cynosura Say, Journ. Ac. Phila. VIII, p. 30, 1839.

Cordulia lateralis and *T. cynosura* Hagen, Syn. Neur. N. A., pp. 139 and 140, 1861.

T. cynosura Kirby, Synonymic Cat., 1890.

Ab. male 28, female 27; h. w. male 28, female 29.

Male.—Brown, markings obscure, yellowish; frons above usually without a black T spot. Thorax covered with long gray pile. Abdomen with a yellow spot on either side of 2-9. Hind wings with black or brown at base, variable in extent; there may be a small basal and a small anal spot, not connected (*cynosura*), or these may be joined and extend on the wing beyond the triangle or to and beyond the nodus (*semiaquea*). Superior abdominal appendages as long as 9+10, seen from above evenly curved, meeting at the middle, apical two-thirds thickened.

Female.—Similar. Appendages shorter than 9+10. Vulvar lamina longer than 9, bifid for almost its entire length.

Nova Scotia, Quebec; Maine, Massachusetts, New York, Pennsylvania, District of Columbia, South Carolina, Georgia, Florida, Louisiana, Michigan, Ohio, Illinois, Indiana.

Christiana Creek, May 26, 1897; Simonton Lake, June 9, 1897; Elkhart, May 11, 1899, one male, flying in the woods (Weith); Marshall County, May 18, 1899; Crawford County, July 8, 1899 (Blatchley); Round and Shriner lakes, June 7, 1898, abundant, almost in flocks along the shores of the lakes; observed also in woodland and along roads in open country.

May, June and July. Apparently this species is of short seasonal range in any locality. On June 11, 1898, while riding on a bicycle along the northern side of the Grand Reservoir in Ohio, about twilight I passed through a small flock of this species of dragonfly. Three struck me in the face and several struck my body and the bicycle.

NEUROCORDULIA Selys (*neuron* Gr., a nerve; *Cordulia*, a genus of dragonflies, *cordyle* Gr., a club).

Selys, Bull. Ac. Belg. XXXI (2), p. 278, 1871.

A genus of four species, confined to North America.

N. OBSOLETA Say (*obsoletus* L., worn out).

Libellula obsoleta Say, Journ. Ac. Phila. VIII, p. 28, 1839.

Didymops obsoleta Hagen, Syn. Neur. N. A., p. 136, 1861.

N. obsoleta Kirby, Synonymic Cat., 1890.

Ab. male 30, female 34; h. w. male 30, female 34.

Male.—Dull brown, obscurely marked; thorax above with a short transverse line on each side anteriorly, and sides with a spot, yellow. Wings with a yellowish spot on each antecubital and near the arculus, and triangle of hind wings with a yellow spot. Superior appendages with the apical half thickened, no abrupt angle on the lower surface.

Female.—Similar. Wings with larger spots; a spot at nodus, at base of front wings, and on anal part of hind wings.

Massachusetts, Pennsylvania, Illinois, Louisiana, Ohio, Indiana.

“Inhabits Indiana and Massachusetts” (Say.)

Mr. Hine writes me that Dr. Dury took this species at Walnut Hills, Cincinnati, during the last part of May and the first part of June, 1899.

SOMATOCHLORA Selys (*soma* Gr., body; *chloros* Gr., green).

Selys, Bull. Ac. Belg. XXXI (2), p. 279, 1871.

A genus of 36 named species, represented in North and South America, Europe, Asia, Australia and adjoining islands. As species have been identified, four may be expected in the State. Say described his *Libellula tenebrosa* from Indiana, and this is our only positive record. The species are all largely metallic green in coloration. They are difficult of identification, the abdominal appendages of the male and the vulvar lamina of the female offering almost the only characters.

The writer has seen only one species of the genus in life. Individuals of this species were flying back and forth along a small stream, occasionally hovering for several seconds in one spot, then moving swiftly to another location or flying away to return again in a few minutes. Their

flight was very swift and strong, and none were seen at rest. Our species may be expected in the southern and more mountainous parts of the State.

Hind wings with an internal triangle. 1.

Hind wings without an internal triangle. Superior appendages of the male a little longer than 10, constricted at the base, where they bear an inferior tooth, then thickened and curved inwards; inferior a little shorter, subtriangular, apex obtuse. Vulvar lamina short. *libera*.

1. Superior appendages of the male longer than 9+10, abruptly bent at the middle, the apical halves almost at right angles to the basal halves and directed toward each other; the truncate point of the inferiors lying just in front of the approximated points of the superiors, suddenly upcurved at apex. Vulvar lamina longer than 9, forming a compressed trough at right angles to the abdomen. *tenebrosa*.

Superior appendages of the male not as in *tenebrosa*; inferior not truncate. 2.

2. Superiors of the male not as long as 9+10, curved at base, with two external teeth; apex bifid, the external branch bent downwards; inferior a little shorter. Vulvar lamina longer than 9, at right angles to the abdomen. *linearis*.

Superiors of the male longer than 9+10, no external teeth, terminating in a small hook turned downwards and inwards; inferior more than half as long. Vulvar lamina forming a recurved trough, reaching to the tip of the abdomen. *filosa*.

S. LINEARIS Hagen (*linearis* L., with lines).

Cordulia linearis Hagen, Syn. Neur. N. A., p. 137, 1861.

S. linearis Kirby, Synonymic Cat., 1890.

Ab. male 46, female 47; h. w. male 43, female 45.

Male and female.—Metallic or brassy green; lips and face below yellowish and brownish; frons above and vertex brassy green. Thorax obscure brassy green. Abdomen brownish black, 2-8 with a round basal spot on each side. Wings sometimes tinged with brown.

Pennsylvania, Georgia, Illinois, Missouri.

S. FILOSA Hagen (*filum* L., a thread).

Cordulia filosa Hagen, Syn. Neur. N. A., p. 136, 1861.

S. filosa Kirby, Synonymic Cat., 1890.

Ab. male 41, female 48; h. w. male 38, female 43.

Male and female.—Similar to *linearis*, more metallic. Thorax each side with two yellow stripes, one under each wing. Abdomen with pale on the sides of 1-3.

Maryland, Georgia, New Jersey, Illinois (Adams).

S. TENEBROSA Say (*tenebrosus* L., dark, gloomy).

Libellula tenebrosa Say, Journ. Ac. Phila. VIII, p. 19, 1839.

Cordulia tenebrosa Hagen, Syn. Neur. N. A., p. 137, 1861.

S. tenebrosa Kirby, Synonymic Cat., 1890.

Ab. male 38, female 39; h. w. male 38, female 37.

Male and female.—Brown or obscure green; lips and face yellowish and brown; frons above metallic; vertex and occiput brown. Thorax on the sides with a posthumeral and median green stripe, each followed by a short or rounded yellow stripe. Abdomen bronze black, 1-3 with pale on the sides. Hind wings sometimes yellowish brown along the anal border.

Nova Scotia; Maryland, New Hampshire, New York, New Jersey, Illinois, Indiana.

“Inhabits Indiana” (Say).

S. LIBERA Selys (*liber* L., free).

Cordulia libera Selys, Bull. Ac. Belg. XXXI (2), p. 263, 1871.

S. libera Kirby, Synonymic Cat., 1890.

Ab. male and female 29; h. w. male 29, female 31.

Male and female.—Obscure metallic green; lips yellow, face and frons brown. Thorax obscurely brown and metallic green. Abdominal segments 2 and 3 marked with brown. Wings with yellowish brown, especially on the hind wings, confined to the extreme base.

Canada; Michigan, New York, Maine.

PANTALA Hagen (*pan* Gr., all; *ala* L., wing).

Hagen, Syn. Neur. N. A., p. 141, 1861.

A genus of two species. One is confined to North America, the other is cosmopolitan. One species has been taken in the State and the other is sure to be found. They fly during July and August, and are very difficult to capture, moving swiftly, sometimes at a considerable height from the ground, and apparently never alighting. They are to be found rarely in almost any environment.

Anal angle with no distinct fuscous spot. *flavescens*.

Anal angle with a distinct fuscous spot. *hymenæa*.

P. FLAVESCENS Fabricius (*flavescens* L., turning light yellow).

Libellula flavescens Fabricius, Ent. Syst. Suppl., p. 285, 1798.

Pantala flavescens Hagen, Syn. Neur. N. A., p. 142, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 32, female 33; h. w. male 41, female 40.

Male and female.—Yellowish. Abdomen with a maculate mid-dorsal stripe, absent on some of the segments, and sides below of 1–8, black. Hind wings with anal margin yellowish; apices sometimes tinged.

Asia, Africa and America; New York, Massachusetts, Pennsylvania, Maryland, Virginia, Georgia, Florida, Wisconsin, Illinois, Missouri, Ohio.

P. HYMENÆA Say (*Hymenæus* L., god of marriage).

Libellula hymenæa Say, Journ. Ac. Phila. VIII, p. 18, 1839.

Pantala hymenæa Hagen, Syn. Neur. N. A., p. 142, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 30, female 31; h. w. male 41, female 42.

Male and female.—Colors reddish brown, marked with dark brown. Abdomen more or less banded and ringed. Hind wings with the anal angle yellowish and with a round, dark yellowish brown spot; and apices sometimes tinged.

Mexico, Cuba; Pennsylvania, Illinois, South Dakota, Texas, New Mexico, Kansas, Ohio, Indiana.

“Inhabits Indiana” (Say).

TRAMEA Hagen (*trama* L., a woof, a spider's web).

Hagen, Syn. Neur. N. A., p. 143, 1861.

A genus of about 32 species, represented in North and South America, India, Africa, Australia, and islands of the Indian and Pacific oceans. Three species have been taken in Indiana. In flight any of these three can be distinguished from all our other Odonata by the colored bases of the hind wings. They may be met with about lakes and ponds, over fields and along roads. *T. lacerata* is the commonest species. All are swift fliers and difficult to catch. They may be expected from May till September.

Adults with basal part of hind wings reddish or yellowish brown. 1.

Adults with basal part of hind wings black, scarcely reaching the costa, not hyaline between the median and the upper sector of the arculus on a level with the triangle. *lacerata*.

1. Brown reaching the costa, and extending to the fourth antecubital; basilar space hyaline in part, colored on the apical side of the arculus. *carolina*.

Brown usually not reaching the costa, extending only to the second antecubital; basilar and space outside of it between the median and the upper sector of the arculus hyaline, thus separating the colored area into a small anterior and a large posterior spot. *onusta*.

T. CAROLINA Linné.

Libellula carolina Linné, Cent. Ins., p. 28, 1763.

T. carolina Hagen, Syn. Neur. N. A., p. 143, 1861; Kirby, Synonymic Cat., 1890.

Ab. male and female 32; h. w. male and female 42.

Male and female.—Reddish brown. Abdominal segments 8–10 black above. Front wings slightly yellowish at base; hind wings with the colored area more evenly edged along the exterior than in *onusta* or *lacerata*, the hyaline anal spot relatively smaller; from this spot across the colored area in its narrowest part is about seven mm.; the corresponding part in *onusta* and *lacerata* measures about four mm. Male superior appendages a little longer than 9+10. Hamule little if any longer than genital lobe. Vulvar lamina of the female not quite as long as 9.

Massachusetts, Pennsylvania, New York, New Jersey, Florida, Ohio, Indiana.

Lake, Jackson Township, Wells County, May 7, 1899, common (Deam).

T. ONUSTA Hagen (*onustus* L., burdened).

T. onusta Hagen, Syn. Neur. N. A., p. 144, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 31, female 33; h. w. male 40, female 42.

Male and female.—Reddish brown. Front wings tinged at base; hind wings with a reddish brown basal area. Male superior abdominal appendages a little longer than 9–10. Hamule much longer than the genital lobe. Vulvar lamina of the female as long as 9, bilobed.

Mexico, Panama, West Indies; Missouri, Florida, Texas, Ohio, Illinois (Adams), Indiana.

Frantz Fishpond, July 4, 1898, common, pairing and ovipositing; the female oviposits in the same manner as the *Libellulas*, the male usually remaining near.

T. LACERATA Hagen (*laceratus* L., torn).

T. lacerata Hagen, Syn. Neur. N. A., p. 145, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 36, female 35; h. w. male 43, female 44.

Male and female.--Brownish black. Dorsum of abdomen with white or greenish spots, 7 usually conspicuously light colored, especially in the female. Front wings with a little brown at base; hind wings with black; in tenerals this is reddish or yellowish brown. Male superior abdominal appendages as long as 8+9+10. Hamule shorter than the genital lobe. Vulvar lamina of the female half as long as 9, bilobed.

Mexico, Sandwich Islands; New York, Pennsylvania, Maryland, Michigan, Illinois, Missouri, Texas, Ohio, Indiana.

Turkey Lake (Kellicott), Round and Shriner lakes, September 2, 1897, June 7 and 24, 1898, only teneral individuals observed on September 2; Frantz Fishpond, July 4, 1898, common, pairing and ovipositing.

PERITHEMIS Hagen (*peri* Gr., around; *Themis* Gr., the goddess of justice).

Hagen, Syn. Neur. N. A., p. 185, 1861.

A genus including seven or eight species, represented in North and South America and the West Indies. A single species occurs in Indiana.

P. DOMITIA Drury (a Latin proper name).

Libellula domitia Drury, Ill. Ex. Ent. II, p. 83, 1773.

L. tenera Say, Journ. Ac. Phila. VIII, p. 31, 1839.

P. domitia Hagen, Syn. Neur. N. A., p. 185, 1861; Kirby, Synonymic Cat., 1890.

Tenera, *tenuicincta* and *iris*, regarded by Hagen and Calvert as varieties of *domitia*, are given specific rank by Kirby in his *Catalogue*.

Ab. male 14, female 13; h. w. male 18, female 19.

Male.—Yellowish brown. Markings obscure, thorax sometimes with two lateral pale stripes, and abdomen with some yellow marks. Wings uniform tawny yellow, or sometimes with a brown spot near the triangle and a basal brown streak on the hind wings.

Female.—Wings hyaline; front wings yellowish along the costa, an area near the triangle and another and larger area at the nodus, yellowish brown bordered with yellow; hind wings similar, the inner colored area covering the triangle and extending backward toward the anal angle. These markings vary greatly. Mr. James Tough, Chicago, showed me a male with the wings colored very much as in the female.

South America, West Indies; United States east of the Mississippi, Texas, Ohio, Illinois, Indiana.

“Inhabits Indiana, Pennsylvania and Massachusetts” (Say); Elkhart, July 2, 1894; marsh near Boot Lake, July 25, 1897, rare (Weith); Eagle Lake, July 10, 1898; Goose Lake, July 11, 1898 (Deam); pond

near Wabash River, Wells County, June 22, 1898; Frantz Fishpond, July 4, 1898, numerous, pairing and ovipositing; June 5, 1899; Lake, Jackson Township, Wells County, September 14, 1899, common (Deam *et al.*); Round and Shriner lakes, August 1, 1896, September 2, 1897, and June 24 and July 21, 1898, usually common.

June to September. A pretty and interesting little species; socially it is a perfect opposite of *Celithemis elisa*. As in other related species (*Celithemis* and *Sympetrum*), the male retains his hold of the head of the female as she flies along near the surface of the water, occasionally striking the water with her abdomen to release the eggs.

CELETHEMIS Hagen (*celis* Gr., a stain, a spot; *Themis* Gr., the goddess of justice).

Hagen, Syn. Neur. N. A., p. 147, 1861.

A genus of four species, represented in North America and Cuba. Three species have been taken in Indiana. The habits of all are very similar. They prefer lakes and are rarely if ever taken along streams. Occasionally they are found far from water but winds have probably carried them from more congenial surroundings. They are usually found along reedy shores, resting on the tips of sedges and grasses growing in or near the water. They pair at rest, the male clinging to any convenient support. During oviposition the male retains his hold of the female's head.

Wing markings yellowish or reddish brown; pterostigma red or yellow. 1.

Wing markings dull brown or black, pterostigma the same color. *fasciata*.

1. Wings yellowish marked with yellowish brown; nodal spot extending almost the full width of the wing. *eponina*.

Wings hyaline marked with yellowish or reddish brown; nodal spot small and rounded, beyond the nodus. *elisa*.

C. EPONINA Drury (*Epona* L., the goddess of horses).

Libellula eponina Drury, Ill. Ex. Ent. II, p. 86, 1773.

C. eponina Hagen, Syn. Neur. N. A., p. 147, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 26, female 24; h. w. male 33, female 32.

Male and female.—Reddish brown and yellow. Thorax with a mid-dorsal and two lateral stripes, blackish. Abdomen black, with yellow spots. Front wings with a spot covering much of the triangle and lying above and internal to it, a nodal band running from the costa almost to

the posterior margin, and a band of similar width and length just inside the pterostigma; hind wings similarly marked, a spot extending from the base to and covering the triangle, and a rounded spot behind this; nodal band constricted at the middle, sometimes divided to form two spots. The extent of the markings is subject to considerable variation.

Cuba; United States east of the Rocky Mountains; Ohio, Michigan, Illinois, Indiana.

"Inhabits Pennsylvania and Indiana" (Say); Turkey Lake (Kellicott); Elkhart, June 12, 1895, margin of pond, rare; Boot Lake, July 4, 1897, usually common; Simonton Lake, July 5, 8 and 9, and August 1, 1897, usually common (Weith); Chapman Lake, July 7, 1898; Goose Lake, July 11, 1898; Lake, Jackson Township, Wells County, June 25, 1899 (Deam); Round and Shriners lakes, August 1, 1896; September 2, 1897; and June 24 and July 21, 1898, common, observed pairing on all dates.

C. ELISA Hagen (a proper name).

Diplax elisa Hagen, Syn. Neur. N. A., p, 182, 1861.

C. elisa Kirby, Synonymic Cat., 1890.

Ab. male 21, female 19; h. w. male 26, female 25.

Male and female.—Yellow or red, marked with deep brown or black. Thorax with mid-dorsal carina, humeral and two lateral sutures more or less black. Abdomen black with dorsum of 3-7 and sides of 1-3 largely red or yellow. Front wings with the ante- and postcubitals and some other cross-veins edged with brown; a small spot above the triangle (often wanting), a rounded spot near the costa between the nodus and the pterostigma, and apex from the pterostigma, brown, the extreme apex hyaline in the female; hind wings similar, a large brown basal area, bounded by the submedian and upper sector of the arculus in front, extending beyond the triangle, and running backward almost to the posterior and anal margin; this brown area enclosing a paler tawny area.

Canada; Maine, New York, Massachusetts, Georgia, Michigan, Illinois, Ohio, Indiana.

Christiana Creek, July 8, 1895, scarce; Boot Lake, July 5 and 9, 1895, and July 4, 1897 (Weith); Chapman Lake, July 7, 1898; Goose Lake, July 11, 1898 (Deam); Frantz Fishpond, July 4, 1898, and June 5, 1899, rare (Deam *et al.*); Round and Shriners lakes, August 1, 1896, September 2, 1897, and June 7 and 24 and July 21, 1898, usually common, observed pairing on all dates but June 7.

This species may often be found resting on the inflorescence of some of the rushea, preferably of the bulrush, *Scirpus laeustris*, growing in the shallow waters of our lakes. So perched on a swinging rush, they have a wide view of what is going on about them and at the same time are inconspicuous, harmonizing well with the dingy brown of the over-ripe

flowers to which they cling. From this vantage ground they make sudden dashes at passing diptera and smaller dragonflies, often returning to the identical sedge time and again. Each is proprietor of a particular locality. When one encroaches on the hunting territory of another he is quickly hustled away by the rightful and irate owner. Quarrelsome among themselves, they are moreover "the butt of Odonate society, for *Anax*, *Libellula* and *Celithemis eponina* are sure to pay it their disrespect whenever they spy it in passing."—Kellicott. The females are more retired, and are usually found among the sedges back from the water's edge.

C. FASCIATA Kirby (*fascia* L., a band, a stripe).

C. fasciata Kirby, Trans. Zoöl. Soc. Lond. XII, p. 326, 1889;
Synonymic Cat., 1890; Hine, Ent. News X, p. 1, 1899.

Ab. male 22, female 21; h. w. male 28, female 27.

Male and female.—Blackish, with yellow markings, showing more distinctly in younger specimens. Antehumeral stripe and much of the sides yellow. Abdomen with a maculate dorsal stripe and spots on sides of segments, yellow. Front wings black at nodus and from there toward the base of the wing, usually as two branches, one between the subcostal and the median, the other between the submedian and the postcosta; the antecubitals of the second series are more or less surrounded with black; a spot between the nodus and the pterostigma, sometimes divided to form two spots, one behind the other; apex black (male), or with a black stripe just before the tip (female); hind wings similar; the spot from base to nodus sometimes with its outer lower part curved backward and inward toward the anal angle; a round anal spot.

Canada; Georgia, Florida, Ohio, Indiana.

Goose Lake, July 11, 1898 (Deam); Round and Shriner lakes, August 1, 1896, September 2, 1897, and June 24 and July 21, 1898, usually rare, several pairs taken on June 24; Frantz Fishpond, July 4, 1898, one male.

LEUCORHINIA Brittinger (*leucos* Gr., white; *rhis* Gr., the nose).

Brittinger, Sitzb. Ak. Wiss. Wien IV, p. 333, 1850.

A genus of 10 species, represented in North America, Europe and Japan. One species has been taken in Indiana. *Proxima*, *glacialis* and *frigida* have been taken east and west of Indiana, but farther north. None of them have been taken in northern Ohio, northern Illinois, or Michigan, and to find any of them in northern Indiana would be a surprise.

L. INTACTA Hagen (*intactus* L., untouched).

Diplex intacta Hagen, Syn. Neur. N. A., p. 179, 1861.

L. intacta Kirby, Synonymic Cat., 1890.

Ab. male 22, female 21; h. w. male 25, female 26.

Male.—Black; face and frons above ivory-white. Sides of abdomen dark brown, obscurely marked with black. Abdominal segment 7 with a yellow dorsal basal spot. Front wings with a little black at base between the subcosta and median and the submedian and postcosta; hind wings with a basal streak, and behind it a triangular basal spot. Superior appendages with a ventral subapical process; inferior deeply and broadly bifid, apices pointed.

Female and younger male.—Similar; face obscured with yellowish. Thorax with obscure yellowish markings above and on the sides. Abdominal segments 2-7 each with a dorsal yellow spot. Wings tinged with yellowish about the black basal areas. Vulvar lamina consisting of two short, slender, separated lobes.

Nova Scotia, Canada to Pennsylvania; South Dakota, Nevada, Washington, Michigan, Ohio, Illinois, Indiana.

Elkhart, June 10 to 25, 1895; and June 10, 1897, not common (Weith); Marshall County, May 18, 1899 (Blatchley); Round and Shiner lakes, June 7 and 24, 1898, teneral and adults were abundant on both dates.

May, June and July. A common and odd little species, distinguished at once, as it hovers about the collector carefully studying his intentions, by its dark color with the clear ivory-white on its head.

SYMPETRUM Newman (*sympiedgo* Gr., to press together; *etron* Gr., the abdomen).

Newman, Ent. Mag. I, p. 511, 1833.

A genus, as defined by Kirby, of about 46 species, represented in North and South America, Europe, Asia and Africa. Four species have been taken in Indiana and at least one more is sure to be found. The habits of all are very similar. They are common about lakes and ponds during July, August and September, and even later. *Vicina* flies until in November. Sometimes specimens are found in great numbers in dry meadows; and every bit of low swampy ground is sure to swarm with them during August. *Corruptum* is more swift and wary than the others. All are conspicuous by their yellow (young) or bright red (adult) colors.

Triangle of front wing usually free; sectors of triangle of hind wings separate at their origin (*Diplacodes* Kirby). *minusculum*.

Triangle of front wing usually crossed; sectors of triangle of hind wings joined or but little separated at their origin (*Sympetrum*). 1.

1. Abdominal segment 4 with a median transverse carina; hind wing about 30 in length. *corruptum*.

Abdominal segment of 4 without a median transverse carina. 2.

2. Superior appendages of the male with a prominent median ventral tooth; vulvar lamina of the female bifid or incised. 3.

Superior appendages of the male denticulate beneath, no prominent median tooth; vulvar lamina of the female entire. 4.

3. Internal branch of hamules as long or longer than the external. *Rubicundulum* and *albifrons*.

Internal branch of hamules small, shorter than the external. *obtrusum*.

4. Hind wings with yellow extending more or less distinctly to the nodus. *semicinctum*.

Hind wings with yellow confined to the base. *vicinum*.

S. RUBICUNDULUM Say (*rubicundulus* L., somewhat ruddy). Pl. VII, figs. 16 and 18.

Libellula rubicundula Say, Journ. Ac. Phila. VIII, p. 26, 1839.

Diplax rubicundula Hagen, Syn. Neur. N. A., p. 176, 1861.

S. rubicundulum Kirby, Synonymic Cat., 1890.

Ab. male 25, female 24; h. w. male 26, female 25.

Male.—Yellow to red. Abdomen with lateral black markings. Wings yellow at base or with yellow extending to the nodus (var. *assimilata* Uhler). Superior abdominal appendages scarcely as long as 9, slightly upturned at apex, acute; the inferior median tooth is denticulate on its anterior side. Var. *assimilata* has been taken in Whitley and Wells counties. The yellow on the wings is usually distinct, but specimens scarcely distinguishable from the typical *rubicundulum* have been taken pairing with well marked specimens of the variety.

Female.—Similar; brown. Vulvar lamina bifid, the lobes approximate.

Nova Scotia to Maryland; Wyoming, Illinois, South Dakota, Nebraska, Michigan, Ohio, Indiana.

"Inhabits Indiana and Massachusetts" (Say); Elkhart, June 17 to September 11, 1897, in woods and over marshes, usually not common; one male (*assimilatum*) July 2, 1894 (Weith); Eagle Lake, July 9, 1898 (both forms); Goose Lake, July 11, 1898; Wells County, July 31 and September 4 (both forms), 1898; June 5, 1899, a teneral male, in woods; August 6, 1899 (Deam); Round and Shriner lakes, September 2, 1897 (both forms); and June 24, 1898, rare; Eel River, Allen County, June 23, 1898, teneral.

S. OBTUSUM Hagen (*obtrusus* L., obtuded). Pl. VII, fig. 19.

Diplax obtrusa Hagen, Stet. Ent. Zeit. XXVIII, p. 95, 1867.

Note after *D. rubicundula*, Syn. Neur. N. A., p. 177, 1861.

S. obtrusum Kirby, Synonymic Cat., 1890.

Ab. male and female 23; h. w. male and female 23.

Male and female.—Very similar to the preceding. In adult specimens the face is more nearly white than in *rubicundulum*, in which species it is yellowish or reddish. Males are distinguished by the hamules. The females are distinguished with more difficulty: *obtrusum* has the vulvar lamina bifid, the conical lobes contiguous to the acute apex; *rubicundulum* has the lobes more inflated, less tapering, less acute, and divergent at the extreme apex. The females of *obtrusum* are olive brown in color with perhaps a reddish tinge. I have never seen *rubicundula* of this color. Both sexes of *obtrusum* are smaller than *rubicundulum*.

Nova Scotia to Pennsylvania; Massachusetts, Wisconsin, Colorado, Washington, Michigan, Ohio, Illinois (Adams), Indiana.

Elkhart, June 14, 1897, over marsh; October 11, 1899 (Weith); Goose Lake, July 11, 1898; Lake, Jackson Township, Wells County, September 4 and 10, 1898, and September 14, 1899, very numerous, pairing (Deam); Round and Shriner lakes, September 2, 1897, and June 24, 1898, common; Blue River, Whitley County, June 23, 1898.

S. ALBIFRONS Charpentier (*albus* L., white; *frons* L., front).

Libellula albifrons Charpentier, Lib. Eur., p. 81, 1840.

Diplax albifrons Hagen, Syn. Neur. N. A., p. 177, 1861.

S. albifrons Kirby, Synonymic Cat., 1890.

Ab. male and female 24; h. w. male and female, 25.

Male and female.—Reddish yellow. Abdomen red (adult) or yellow (young) spotted with black. Wings with the extreme base yellow. Hamules long, bifid, the external branch small, truncated, internal branch longer, narrow. Vulvar lamina short, rounded, the apex incised.

Massachusetts, Georgia, Missouri, Texas, Illinois (Adams).

S. VICINUM Hagen (*vicinus* L., neighborly). Pl. VII, figs. 17 and 20.

Diplax vicina Hagen, Syn. Neur. N. A., p. 175, 1861.

S. vicinum Kirby, Synonymic Cat., 1890.

Ab. male 21, female 22; h. w. male 24, female 23.

Male and female.—Colors similar to *rubicundulum*. Wings with the base only yellow.

Canada; Maine, New York, New Hampshire, Massachusetts, New Jersey, Pennsylvania, Maryland, District of Columbia, Virginia, Illinois, Michigan, Ohio, Indiana.

Turkey Lake (Kellicott); Elkhart, September 18 and 23, 1895, over marsh, common (Weith); Eagle Lake, July 11, 1898; Goose Lake, July 12, 1898; Wells County, September 4, 1898, and July 20, 1899 (Deam); Round and Shriner lakes, September 2, 1897, June 24 and July 21, 1898, very abundant, pairing on September 2, on June 24 only teneral were observed.

S. SEMICINCTUM Say (*semi* L., half; *cinctus* L., encircled).

Libellula semicincta Say, Journ. Ac. Phila VIII, p. 27, 1839.

Diplax semicincta Hagen, Syn. Neur. N. A., p. 176, 1861.

S. semicinctum Kirby, Synonymic Cat., 1890.

Ab. male and female 20; h. w. male and female 23.

Male and female.—Coloration as in other species, yellow to red, sides of abdomen spotted with black. Front wings yellowish brown from the base to the triangle or nodus; hind wings yellowish brown from the base to the nodus, usually lighter at base. Genitalia of the male much resembling *vicinum*. Vulvar lamina of the female very short, margin entire.

Maine, New York, New Hampshire, Massachusetts, Maryland, Pennsylvania, Colorado, New Mexico, Nevada, California, Michigan, Ohio, Illinois (Adams), Indiana.

“Inhabits Indiana and Massachusetts” (Say); Shriner Lake, July 21, 1898, one male.

S. CORRUPTUM Hagen (*corruptus* L., marred, spoiled). Pl. VII, fig. 21.

Mesothemis corrupta Hagen, Syn. Neur. N. A., p. 171, 1861.

S. corruptum Kirby, Synonymic Cat., 1890.

Ab. male 27, female 28; h. w. male 29, female 30.

Male and female.—Varying greatly in coloration at different ages. Young: thorax yellowish, an antehumeral, narrow humeral, and two lateral stripes terminated below by a bright yellow spot, grayish; later all these markings disappear excepting the lateral yellow spots. Abdomen yellowish, some black on the sides and above on 8 and 9. The fully adult insect is red. Veins and pterostigma yellowish and brown, or red. Legs black, sharply lined with yellow. Male superior appendages thickened apically, with inferior denticles. Vulvar lamina of the female not projecting, apex emarginate.

Asia, Mexico; Pennsylvania, Illinois, Kansas, California, Wyoming, Montana, Colorado, Texas, Louisiana, Ohio.

S. MINUSCULUM Rambur (*minusculus* L., rather small).

Libellula minuscula Rambur, Ins. Névr, p. 115, 1842.

Diplax minuscula Hagen, Syn. Neur. N. A., p. 183, 1861.

Diplacodes minuscula Kirby, Synonymic Cat., 1890.

Ab. male and female 18; h. w. male and female 19.

Male and female.—Yellow, marked with fuscous and black. Abdomen yellow, dorsum with three maculate black stripes and the apex black. Extreme base of hind wings yellow.

Georgia, Florida, Kentucky.

MESOTHEMIS Hagen (*mesos* Gr., middle, between; *Themis* Gr., the goddess of justice).

Hagen, Syn. Neur. N. A., p. 170, 1861.

A genus confined to America; two species are known.

M. SIMPLICICOLLIS Say (*simplex* L., simple; *collum* L., neck).

Libellula simplicicollis Say, Journ. Ac. Phila. VIII, p. 28, 1839.

M. simplicicollis Hagen, Syn. Neur. N. A., p. 170, 1861; Kirby, Synonymic Cat., 1890.

Ab. male 30, female 29; h. w. male and female 31.

Male.—Green and black; face green. Thorax green, sometimes the sutures with black. Abdomen mostly green basally, apical half mostly black. In older males the thorax and abdomen becomes entirely pruinose, grayish blue in color. Superior appendages whitish, denticulate underneath.

Female.—Green and dark brown, similar to the young male. Vulvar lamina elevated, triangular, entire.

Mexico, West Indies, Bahamas; United States east of the Rocky Mountains; Texas, Montana, Utah, Michigan, Ohio, Illinois, Indiana.

“Inhabits Indiana and Massachusetts” (Say); Turkey Lake (Kellcott); Elkhart, July 2, 1894, June 10 to September 17, 1895, June 28, 1899 (Weith); Eagle Lake, July 6, 1898; Chapman Lake, July 7, 1898 (Deam); Wabash River, Wells County, August, 1896, July 31, 1898; Frantz Fishpond, July 4, 1898, June 5, 1899; Lake, Jackson Township, Wells County, June 25, 1899 (Deam *et al.*); Round and Shriners lakes, August 1, 1896, September 2, 1897, and June 7 and 24, and July 21, 1898, usually abundant, pairing and ovipositing in July and September.

Of the dragonflies common about our swamps, marshes and lakes, none is more interesting, perhaps, than this species. The female because of her bright green color and energetic and peculiar method of hunting, is at least as conspicuous as the more soberly colored old males. Diptera

form the bulk of their food, many *Chrysops* justly perishing in this way. They have also been observed to kill and eat butterflies (*Pamphila*), moths, and dragonflies (*Lestes vigilax* and *Argia violacea*). On several occasions and at different localities males have been seen going through maneuverings which are hinted at frequently by some of the *Libellulas*, but which seem to have been perfected only by this species. Two males are necessary for the performance. They flutter motionless, one a few inches in front of the other, when suddenly the rear one will rise and pass over the other, which at the same time moves in a curve downwards, backwards and then upwards, so that the former position of the two is just reversed. These motions kept up with rapidity and regularity give the observer the impression of two intersecting circles which roll along near the surface of the water.

PACHYDIPLAX Brauer (*pachys* Gr., thick; *Diplax* (= *Sympetrum*), a genus of Odonata; *diplax*, a double folded mantle).

Brauer, Verh. zool.-bot. Gesell. Wien XVIII, pp. 368, 722, 1868.

A genus with a single species, found in North America and Mexico.

P. LONGIPENNIS Burmeister (*longus* L., long; *penna* L., a wing).

Libellula longipennis Burmeister, Handb. Ent. II, p. 850, 1839.

Mesothemis longipennis Hagen, Syn. Neur. N. A., p. 176, 1861.

P. longipennis Kirby, Synonymic Cat., 1890.

Ab. male 24, female 22; h. w. male 29, female 28.

Male.—Young: face whitish or greenish, frons above and vertex metallic blue. Thorax dark brown, the following yellowish or greenish: antecular sinus, mid-dorsal carina, antehumeral stripe, humeral stripe, and three broad stripes on the sides. Abdomen black or brown, an interrupted greenish stripe on either side of the dorsum of 2-7, below this on either side a similar interrupted stripe, not continued so far posteriorly. In older males the thorax and abdomen become pruinose and the markings are obscured. Wings hyaline, sometimes tinged with brown, especially between the nodus and pterostigma; dull yellow at base; hind wings sometimes with a short black streak between the subcosta and median, and another between the submedian and postcosta.

Female.—Similar to young male; occasionally pruinose in old individuals.

Mexico, Bahamas, Vancouver's Island; New York, Massachusetts to Florida, west to the Mississippi; Texas, Montana, California, Michigan, Ohio, Illinois, Indiana.

Turkey Lake (Kellcott); Elkhart, June 10 to July 11, 1895; Boot Lake and over marsh, June 27 to July 22, 1897, not common; May 26,

1899, one female in woods (Weith); Eagle Lake, July 5, 1898; Chapinan Lake, July 7, 1898 (Deam); Wabash River, Wells County, August, 1896; June 5, 1899; Frantz Fishpond, June 5, 1899; Lake, Jackson Township, Wells County, May 29, 1899 (Deam *et al.*); Round and Shriner lakes, August 1, 1896; June 24 and July 21, 1898, common.

This species (and more rarely others) will frequently rest on some twig or stem with the wings drooping and the abdomen pointing straight up. The object to be gained by such a position is not evident, for the abdomen makes a favorite mark for passing *Libellulas* to nip at.

NANNOTHEMIS Brauer (*nanos* Gr., a dwarf; *Themis* Gr., the goddess of justice).

Brauer, Verh. zool.-bot. Gesell. Wien XVIII, pp. 369, 726, 1868.

A genus of three known species, represented in North and South America.

N. BELLA Uhler (*bellus* L., pretty, neat).

Nannophya bella Uhler, Proc. Ac. Phila., p. 87, 1857; Hagen, Syn. Neur. N. A., p. 186, 1861.

Nannothemis bella Kirby, Synonymic Cat., 1890.

Ab. male and female 12; h. w. male and female 15.

Male.—Black; face and frons pale, a median black spot connected with the black labrum; vertex metallic green or blue. Thorax and abdomen black. Pruinose in older individuals.

Female.—Similar. Thorax above dark brown, a yellow antehumeral line, and sides yellow with two black lines. Abdomen with following yellow: transverse basal band on 2-4, basal spot on 5-7, and entire dorsum of 10. Wings yellowish on basal third.

Ontario to Georgia; Maine, Massachusetts, New York, Connecticut, New Jersey, Pennsylvania, Maryland, Georgia, Indiana.

Elkhart, June 12, 1895, margin of pond; June 25, 1899, Indiana Lake, over marsh, common, most active towards evening, in the morning taken at rest on the stems of spatterdock leaves (Weith).

LIBELLULA Linné (*libella* L., a water-level).

Linné, Syst. Nat. I, p. 543, 1758.

As used by Hagen and Bauer this genus includes more than 30 species, represented in North and South America, Europe and Asia. Kirby in his *Revision of the Subfamily Libellulinae*, Trans. Zoöl. Soc. Lond. XII, 1889, separates the genus into five genera—*Libellula*, *Leptetrum*, *Plathemis* (?), *Belonia* and *Holotania*. *Libellula exusta* Say is placed in *Leptetrum*. In

the Can. Ent. XXIX, p. 146, Needham, after a study of both nymph and imago, proposes a new genus, *Ladona*, for *L. exusta*. In this paper it is more convenient to use *Libellula* in its wider sense.

About the lakes and marshes of northern Indiana three Odonatological seasons may be recognized—the *Enallagma* season, during which the Gomphines and Cordulines are also abroad; the *Libellula* season, when representatives of almost all the subfamilies may be found but when, as on June 24, I wrote in my note book, “it is the day of *Libellulas*,” and the *Sympetrum* season, when, to be sure, there are many *Lestes*, but they are weak, half-awake people who seem well content to let the hordes of red *Sympettra* rule the regions of hazy air above the dense sedge growths where they rest with listless wings neither closed nor spread. During this season the powerful *Aeschnas* wing their way about the lake, but they are too few in numbers to exercise much control. It is during the *Libellula* season that the shores are well guarded and patrolled. No visitor comes then but is challenged; nothing moves on water or land or through the air that is not noted and questioned. And the collector, followed and watched by many flashing forms, will find himself becoming so unscientific, perhaps, as to credit the members of his escort with psychological processes not unlike his own, but better fitted to the restless bodies that, if only for a short season, know unbounded freedom.

Base of hind wings, to beyond the triangle at least, black for the entire width. *basalis*.

Base of hind wings hyaline, or with the colored area not reaching the posterior edge of the wing. 1.

1. Base of hind wings hyaline, or with colored area not extending to and covering the triangle. 2.

Hind wings with colored area extending from the base to and covering the triangle. 6.

2. Wings hyaline at base, without basal streaks. 3.

Wings with basal streaks. 4.

3. Yellowish or reddish species, pterostigma yellowish. *auripennis*.

Dark species, pterostigma black. *incesta*.

4. A small nodal spot and extreme apex black. *vibrans*.

No nodal or apical markings. 5.

5. Wings each with a basal streak, sometimes two on hind wings; pterostigma bicolored. *cyanea*.

Front wings with two basal streaks, hind wings with a basal streak and a triangular spot back of it; pterostigma unicolored. *exusta*.

6. Nodal spot small, wings hyaline beyond it. *quadrinaculata*.

Nodal spot larger, another spot at pterostigma or apex, or the area between nodus and pterostigma, from costa to hind margin of wings, black. 7.

7. Wing spots yellowish; basal spot on hind wing behind the submedian. *semifasciata*.
Wing spots black or dark brown; basal spot on hind wings almost reaching the costa. 8.
8. Each wing with three spots. 9.
Each wing with a basal spot and the entire area between nodus and pterostigma black. (*Plathemis lydia* male, see p. 333.)
9. Triangle of front wings more or less brown or black. *pulchella*.
Triangle of front wings entirely hyaline. (*Plathemis lydia* female, see p. 333.)

L. BASALIS Say (*basis* Gr., base).

L. basalis Say, Journ. Ac. Phila. VIII, p. 23, 1839.

L. luctuosa Hagen, Syn. Neur. N. A., p. 152, 1861.

Belonia luctuosa Kirby, Synonymic Cat., 1890.

Ab. male 31, female 27; h. w. male 40, female 38.

Male.—Blackish brown. Abdomen yellow on either side, this obscure in older individuals. Wings with basal third to half dark brown or black, on the front wings darkest beyond the base; in older individuals chalky white beyond the black almost to the pterostigma.

Female.—Wings with less black, sometimes only a dark tinge extending to the triangle on the front wings; no chalky white beyond the black area; apices usually dark.

Canada; New York, New Jersey, Pennsylvania, Maryland, District of Columbia, Michigan, Illinois, Kansas, South Dakota, Texas, Iowa, Ohio, Indiana.

Elkhart, May 31 to July 12, 1895, common; Boot Lake, July 4, 1897, common (Weith); Eagle Lake, July 5, 1898; Chapman Lake, July 7, 1898 (Deam); Wells County, July 31, 1898; pond near the Wabash, Wells County, June 22, 1898; Frantz Fishpond, July 4, 1898, abundant, ovipositing; June 5, 1899 (Deam *et al.*); Round and Shriner lakes, August 1, 1896, September 2, 1897, June 7 and 24, and July 21, 1898, very abundant, only tenerals observed on June 7, ovipositing on June 24, July 21 and September 2; Eel River, Allen County, June 23, 1898.

L. AURIPENNIS Burmeister (*aureus* L., golden; *penna* L., a wing).

L. auripennis Burmeister, Handb. Ent. II, p. 861, 1839; Hagen, Syn. Neur. N. A., p. 155, 1861.

Holotania auripennis Kirby, Synonymic Cat., 1890.

Ab. male 38, female 36; h. w. male 40, female 39.

Male and female.—Yellow or reddish brown. A yellow mid-dorsal thoracic stripe on young individuals. Abdomen with a mid-dorsal black

stripe. Wings yellowish or reddish, especially along the front margin; apices sometimes brown.

Cuba, Isle of Pines; Atlantic and Gulf States south of New York; Ohio.

L. INCESTA Hagen (*incestus* L., impure, polluted). Pl. III; Plate IV, fig. 1.

L. incesta Hagen, Syn. Neur. N. A., p. 155, 1861; Calvert, Trans. Am. Ent. Soc. XVII, p. 34, 1890.

Holotania incesta Kirby, Synonymic Cat., 1890.

Ab. male 35, female 33; h. w. male 39, female 38.

Male and female—Yellowish and reddish brown, similar to the preceding. Older males dark pruinose blue. Wings hyaline, nodus sometimes edged with dark, and apex sometimes dark.

Canada to Florida; Maine, New Hampshire, Massachusetts, Carolina, Texas, Michigan, Ohio, Illinois (Adams), Indiana.

Round and Shriners lakes, August 1, 1896, September 2, 1897, and June 24 and July 21, 1898, abundant at certain points, especially the northern shores of Round Lake, ovipositing September 2 and June 24.

L. VIBRANS Fabricius (*vibrans* L., fluttering).

L. vibrans Fabricius, Ent. Syst. II, p. 380, 1793.

L. lydia Hagen, Syn. Neur. N. A., p. 155, 1861.

Holotania vibrans Kirby, Synonymic Cat., 1890.

Ab. male 40, female 38; h. w. male 48, female 47.

Male and female.—Yellow and reddish brown. Mid-dorsal thoracic stripe and sides, yellow, with slight black markings. Abdomen with sides yellow. Older males pruinose, the markings obscure. Wings with a long basal streak between the subcosta and median, a dot at the nodus, and the apex, more so in the female, black.

New York, Pennsylvania and New Jersey to Texas; Ohio, Illinois (Adams).

L. CYANEA Fabricius (*cyaneos* Gr., dark blue).

L. cyanea Fabricius, Syst. Ent., p. 424, 1775

L. quadrupla Hagen, Syn. Neur. N. A., p. 157, 1861.

Leptetrum cyaneum Kirby, Synonymic Cat., 1890.

Ab. male 29, female 27; h. w. male 35, female 34.

Male and female.—Yellow and chocolate brown. Thorax with a mid-dorsal stripe and sides largely yellow. Abdomen with a mid-dorsal brown stripe. Older males become entirely blue pruinose. Front wings

with a basal streak between the subcosta and median; hind wings with a basal streak between the subcosta and the median, and usually a shorter one between the submedian and postcosta; apices of all the wings sometimes brown; yellowish tinges at either end of the bicolored pterostigma.

New York, Massachusetts to Virginia; Pennsylvania, Ohio, Indiana.

Elkhart, generally common about marshes and ponds, taken from June 10 to July 4, 1897; one female in woods, June 14, 1897; Boot Lake, July 4, 1897, common (Weith); Goose Lake, July 11, 1898; Lake, Jackson Township, Wells County, July 31, 1898 (Deam); Shriner Lake June 7 and July 21, 1898, rare.

L. EXUSTA Say (*exustus* L., burned up, consumed).

L. exusta Say, Journ. Ac. Phila. VIII, p. 29, 1839.

L. deplanata Hagen, Syn. Neur. N. A., p. 154, 1861.

Leptetrum exustum Kirby, Synonymic Cat., 1890.

Ab. male 25, female 23; h. w. male 30, female 29.

Male and female.—Dark reddish brown. An antehumeral pale stripe. Abdomen with a mid-dorsal black stripe. Thorax above and abdomen white pruinose in old males. Bases of wings yellowish; front wings with two basal streaks; hind wings with a superior basal streak, behind it a triangular spot.

Canada, Vancouver's Island; Maine, Massachusetts, New York, Pennsylvania, New Jersey, North Carolina, Florida, Georgia, Wisconsin, Washington, Ohio, Illinois (Adams).

L. QUADRIMACULATA Linné (*quattuor* L., four; *maculatus* L., spotted).

L. quadrimaculata Linné, Syst. Nat. I, p. 543, 1758; Hagen, Syn. Neur. N. A., p. 150, 1861.

Leptetrum quadrimaculatum Kirby, Synonymic Cat., 1890.

Ab. male and female 30; h. w. male and female 35.

Male and female.—Olive or yellowish, marked with black. Humeral and second lateral suture black. Abdomen largely yellow, 6 or 7–10 black above. Wings with more or less yellowish at base and along the costa; a small nodal spot; hind wings with a yellowish black, triangular basal spot.

Europe and Asia; Canada, Nova Scotia; Maine, Massachusetts, New York, New Jersey, Michigan, Illinois, Wisconsin, Idaho, Wyoming, Utah, Washington, Iowa, Ohio, Indiana.

Common at Elkhart about 1890, not seen since then (Weith).

L. SEMIFASCIATA Burmeister (*semi* L., half; *fascia* L., a band, a stripe).

L. *semifasciata* Burmeister, Handb. Ent. II, p. 862, 1839; Hagen, Syn. Neur. N. A., p. 151, 1861.

Leptetrum semifasciatum Kirby, Synonymic Cat., 1890.

Ab. male 27, female 26; h. w. male and female 36.

Male and female.—Reddish or yellowish. Sides of thorax with two pale stripes, more or less distinct. Abdomen yellow, last 4 or 5 segments largely black above. Wings yellowish tinged at base as far as the triangle; veins conspicuously red or yellow; yellowish or reddish brown spots as follows: a nodal spot, a pterostigmal band, sometimes the apex, and usually an anal spot in the hind wings; the following yellowish black: in front wings the apical half of the median space, and the space between the sectors as far as the apex of the triangle; in hind wings a streak from the base, between the submedian and the postcosta, to and covering the triangle, the supratrangular space, and the space between the sectors of the arculus as far as the apex of the triangle.

Maine, New York, Massachusetts, Pennsylvania, New Jersey, Maryland, District of Columbia, Carolina, Florida, Texas, Michigan, Illinois, Ohio, Indiana.

Elkhart, June 13, 1897, one male in a road; June 17 and July 6, 1897, in woods; Boot Lake, July 4, 1897 (Weith); Eagle Lake, July 12, 1898 (Deam).

L. PULCHELLA Drury (*pulchellus* L., beautiful).

L. *pulchella* Drury, Ill. Exot. Ent. I, p. 115, 1770; Hagen, Syn. Neur. N. A., p. 153, 1861.

Plathemis (?) *pulchella* Kirby, Synonymic Cat., 1890.

Ab. male 34, female 32; h. w. male and female 42.

Male and female.—Blackish brown. Sides of thorax with two wide yellowish stripes. Abdomen with a stripe on each side yellow; pruinose in old males; wing spots black or dark brown; a basal spot between the costa or subcosta and the postcosta, to or slightly beyond the triangle, coloring the triangle completely in the hind wings, more or less in the front wings; a large nodal and an apical spot; male usually with anal portion of hind wings and spots alternating with black spots on all the wings, chalky white.

Quebec to Georgia, west to Utah and Texas; Michigan, Ohio, Illinois, Indiana.

Turkey Lake (Kellicott); Elkhart, June 10 and 12, 1895, very common (Weith); Eagle Lake, July 8, 1898 (Deam); Marion County, May 23, 1899, Crawford County, July 8, 1899 (Blatchley); Round and

Shriner lakes, August 1, 1896, June 7 and 24, and July 21, 1898; Eel River, Allen County, June 23, 1898; Wabash River, Wells County, June 19 and 22, 1898; Frantz Fishpond, July 4, 1898.

PLATHEMIS Hagen (*platos* Gr., broad; *Themis* Gr., the goddess of justice).

Hagen, Syn. Neur N. A., p. 149, 1861.

A North American genus including two species. *Libellula pulchella* is placed in this genus provisionally by Kirby, "though this species *pulchella* has some resemblance to *Holotania*."

P. LYDIA Drury (a proper name).

Libellula lydia Drury, Ill. Exot. Ent. I. p. 112, 1770.

P. trimaculata Hagen, Syn. Neur. N. A., p. 149, 1861.

P. lydia Kirby, Synonymic Cat., 1890.

Ab. male 28, female 24; h. w. male and female 33.

Male and female.—Brown. Thorax each side with two yellowish stripes. A yellow spot on each side of 2-9. Older males with the thorax largely and the abdomen entirely white pruinose. Male with wings marked with dark brown or black as follows: a basal spot, between the costa or subcosta and the postcosta, extending to the triangle in the front wings, and to and covering the triangle in the hind wings; basilar space more or less hyaline; and a wide band, between the nodus and pterostigma, for the entire width of the wing; a chalky white spot behind each basal spot, sometimes wanting on the front wings. Female with wing markings much like *Libellula pulchella*, triangle of front wings entirely hyaline.

Quebec to Florida, west to Colorado; Washington to southern California, Michigan, Ohio, Illinois, Indiana.

Turkey Lake (Kellicott); Elkhart, June 16, 19 and 26, 1895, very common; July, 1896; May 23, 1897, one female in thick woods on high ground; Christiana Creek, May 25, 1897; Boot Lake, July 4, 1897, common (Weith); Eagle Lake, July 9, 1898 (Deam); Crawford County, July 8, 1899 (Blatchley); Wabash River, Wells County, June 22, 1898, ovipositing; July 12, 1899 (Deam *et al.*); Frantz Fishpond, July 4, 1898, numerous; Round and Shriner lakes, August 1, 1896, June 7 and 24, and July 21, 1898, common; Eel River, Allen County, June 23, 1898.

A DESCRIPTIVE
ILLUSTRATED CATALOGUE
OF THE
MOLLUSCA
OF INDIANA.

BY RICHARD ELLSWORTH CALL,
PH. D., M. A., M. D.

LETTER OF TRANSMITTAL.

Prof. W. S. Blatchley, State Geologist:

SIR—I hand you herewith my report on the Mollusca of Indiana, prepared in accordance with instructions received from you.

In this paper I have endeavored to fully present the present condition of knowledge relating to these forms in Indiana. It is only fair to say that careful and general collecting over the State would probably increase somewhat the number of species and would largely increase the number of localities at which certain forms would occur, but such extensive collecting appears to be a remote contingency.

The information contained herein is based upon my own personal collecting in the State and on information derived from the shells submitted to me, from time to time, by the persons named below. It has been my plan throughout to make the paper of use to Indiana students who may wish to take up this inviting field of natural history and whose opportunities in the way of authentic collections and the extensive literature are limited. Most of the species are illustrated; the Unios are rather fully depicted in the large series of plates which I submit herewith, and which for the first time, will put this difficult group in a properly illustrated form into the hands of Indiana educators. The drawings have been carefully made and are from Indiana shells, for the greater part. Only a very few forms are not illustrated, and they are such as could be readily identified without illustration.

I am indebted to your courtesy for opportunity to re-describe many critical forms from the collections of the State Museum, an especially desirable thing, for many of the earlier named forms have never been properly described. To the following gentlemen I am also indebted for occasional specimens: Mr. A. W. Butler, Indianapolis; Professor Voorhees, Brookville; Professor J. T. Scoville, Terre Haute; Professor Barton W. Evermann, Washington; Professor Joseph Moore, Richmond; and to the Biological Experiment Station of the Indiana University, at Turkey Lake, for opportunity to examine such shells as that organization collected.

I trust that this report will prove of service in the high schools and colleges of the State, and lead to some general interest in a much neglected branch of the zoology of Indiana.

Very truly,

R. ELLSWORTH CALL.

Brooklyn, N. Y., July 1, 1898.

A DESCRIPTIVE ILLUSTRATED CATALOGUE OF THE MOLLUSCA OF INDIANA.

BY RICHARD ELLSWORTH CALL, PH.D., M.A., M.D.

This catalogue is intended to be complete and to fully exhibit the present state of knowledge concerning the group of which it treats, as presented in the fauna of Indiana. To render its completeness more perfect, all the literature of the subject has been carefully passed in review and all authenticated facts of distribution have been added to those which long personal collection and study of Indiana mollusks have brought to light. Yet, great as the care exercised has been, I can not hope to have included all the known facts of distribution in the State, but believe that all facts of undoubted occurrence of species are included.

Indiana mollusks have long been known. Among the very earliest published papers on American shells are those of Thomas Say, formerly of New Harmony, who may justly be called the father of American conchology. Contemporaneous with him was C. S. Rafinesque, mainly known for his botanical and ichthyological work, who first described many forms from the Ohio River and especially from that portion which flows along the southern boundary of Indiana. But the land shells were first and most completely studied, and most of the earlier work was accomplished among the land forms. Say described from the region around New Harmony, and sent abroad to his correspondents, many Indiana shells. One form which Say described as in a semi-fossilized condition, from the loess region of the lower Wabash, was *Helicina occulta*, a form which has later been found living in several localities, though none of them are within the bounds of this State. In Iowa, near Iowa City, in western Pennsylvania, and near South Pittsburg, Tennessee, this form is now found living. But strange to say none have yet occurred in Indiana. Other forms which Say, and after him other writers, notably Conrad and Lea, described from Indiana have since been found to be synonyms and are properly to be placed under other forms well-known from elsewhere. For historical purposes a summary list of all forms from Indiana, originally

described from the State, is given below, from which it will be seen that three species of land shells, 29 species of fresh-water shells, univalves, and 21 species of fresh-water bivalves were originally made known from within its borders.

THE GENERAL CHARACTER OF THE SHELL FAUNA.

Nearly all the groups recognized in the eastern province of the interior region, both among land and fresh-water shells, are found represented in this fauna. All, however, are not equally well represented. Certain groups of fresh-water univalves are found to be especially well represented over the northern half of the State, in the region of the glacial lakes, while other groups are but sparsely distributed. Among the *Limnæidæ*, so abundant in the northern half of the State, the individuals are frequently very numerous, the grassy shores and reedy margins of the small lakes within the terminal moraine affording the very best conditions for luxuriant development of this family. But the *Strepomatidæ* are represented by comparatively very few forms. The reverse conditions are exhibited in the southern half of the State. In the Ohio River and its tributaries this group of shells becomes a very conspicuous element of the shell fauna. In the Wabash, as far up as Huntington, two or three species abound, but in respect both to individuals and species the southern portions of the State furnish the greatest variety. Beginning with the Ohio River, which is on the northern margin of the great center of distribution of this family, as far as middle Alabama, the *Strepomatidæ* form a characteristic part of the shell fauna. It would seem that as the Ohio is approached from the north and this great geographic area is entered this group of mollusca appears to become more numerous in both individuals and species until the Coosa River, in Alabama, is reached, where the forms are crowded upon each other and abound beyond one's ability to express numbers. The same facts appear to be true of the *Unionidæ*, which, for probably the same geologic reason, has its metropolis in the great Cumberland plateau. Comparatively few species are found in northern Indiana, and those are all forms of wide distribution. But in the Wabash below Terre Haute, in the South Fork of the White River and in the Ohio both species and individuals abound. The Ohio River forms are widely distributed over the Southern States, especially over Tennessee, Kentucky, Alabama, Georgia and Mississippi, but have been given a great variety of names, most of which must now be relegated to synonymy. They are easily connected by geographic series; the types of most groups there known occur in the Ohio River fauna.

In the case of the land shells there is nothing peculiar to the State except that few species and individuals occur in the northern portions. In the southern parts of the State, however, both species and individuals are more numerous. All species found belong to the Central Province of Binney, except a very few of circumpolar distribution, like *Vallonia pulchella* and *Hyalina arborea*, which are found in all suitable localities all over the State. No land shells from this State are peculiar to it, though several were first made known to science from within its borders.

HABITS OF THE LAND MOLLUSCA.

The student of Indiana mollusca must first learn something of their habits before he can hope to obtain a representative collection. And such knowledge will not be the easiest to obtain. Of course the larger forms will be the first to attract attention and will probably be the first to be secured. The smaller species will only be obtained after a long experience in field work.

As a rule it will not be found profitable to search for land shells far within dense forests nor on dry hillsides with southern exposure. The margins of open woods, where are to be found numerous fallen trees, or in low-lying lands about river bottoms above the annual limit of floods, rich and rocky hillsides with eastern or northern exposure and covered with open forest are good localities. In such situations these retiring animals may be sought with fair chance of success. It will then be learned that on days during light showers, or after heavy rains, while the ground is still moist, from late in March until June and in the fall from September to early frosts, shells can usually be found. Every possible nook and cranny must be carefully searched. On open hillsides, under grass clumps, in situations where the wild ginger, the wild poppy and trillium grow, the larger shells, like *Mesodon elevata*, will be found. On the under side of chips, pieces of bark, in old stumps, under fallen logs, or between the bark and the decaying wood, the smaller forms will be found. On a day after a warm shower from the upper surfaces of fallen trees with rough bark, such as white oak or poplar trees, in river bottoms, many specimens of *Pupa* or *Vertigo* or *Zonites* may be taken which have been driven out of the cracks and folds in the bark by the rain water. In gardens, in the open fields, about the bases of large flat stones, especially in the spring and fall, many examples of *Vallonia* or *Pupa* may be taken. In swamps which have partially dried up but where an abundant growth of reeds is found, after a rain, hundreds of examples of *Succinea* may be taken, clinging to the under sides of the blades, where they are shel-

tered from the direct rays of the sun. In creek bottoms, after storms, clinging to the under side of plants like the ragweed, may be taken large numbers of *Mesodon clausa* or *Mesodon michelliana*. Crawling over the warm surface of the wet sands, in such situations as the last, may be seen hundreds of specimens of *Patula striatella*, and, near Indianapolis and Terre Haute, many examples of the beautiful *Mesodon multilineata*. In short, the collector will soon observe that some species peculiar to nearly all stations will come to light sooner or later. Occasionally a species will be found to be gregarious, especially towards the late fall. Such is the case with *Patula alternata*, which occurs in a great variety of situations all over the State. This shell is probably the most common one in Indiana, and is to be found in every possible situation, sometimes of magnificent development. It is also common to find *Mesodon elevata* and *Mesodon thyroideus* in numbers partially hidden in the soft dirt of damp hillsides which face the north. *Stenotrema monodon* and *Stenotrema hirsutum* are often found in numbers under flat rocks, especially about Madison, on the hillsides along the Ohio River. In these same situations also may be found *Triodopsis tridentata* and *Triodopsis inflecta* and *Triodopsis appressa*, forms which do not appear in the land fauna of the more northern parts of Indiana.

The under surfaces of fallen logs which are partially decayed afford hiding places for numbers of the shellless forms of *Limax* or slugs. The under surfaces of board walks about dwellings, damp places in cellars, or even in the crevices of rocks about well curbs, these forms frequently abound. Usually their presence is made known by a glistening line of shining dry mucus following along which the collector will speedily come to the hiding place of the animal. Traps may be made by laying old boards, not new ones, along the margins of gardens, in yards, or on the margins of forests, and many examples of these animals taken in that way. All forms of this nature should be collected and preserved in alcohol, not only because they are in themselves interesting, but because they have been largely neglected by students of Indiana mollusca. Only a very few forms are now known from this State. Early morning, or late in the afternoon, on damp and dark days, or in damp and secluded ravines, the collector will have best returns for his time and search.

Of the winter habits of these animals very little is known. In this State certain forms, like *Mesodon elevata* and *Mesodon exoleta*, burrow deeply into the earth, boring down into the ground in damp places on hillsides, until eight or ten inches of soil are above them. Here they snugly pass the winter. Others, like *Patula alternata*, collect in num-

bers at the base of old stumps under a thick covering of leaves, and hibernate in that manner. The slugs bury themselves in the decaying materials of logs, under the bark, or crawl far within the clefts of rocks, beyond the reach of frost. Many, indeed, it may safely be said most, perish in the cold of the rigorous Indiana climate, but always enough survive to keep favorable locations well populated with interesting forms. The minute *Pupas* and *Vertigos* and *Vallonias* bury themselves under flat stones or in the earth at the base of grass clumps, where they securely pass the long winter. Of the winter habits of the so-called amphibious *Succineas* nothing is known. It is believed that Indiana students of nature will find this subject of winter habits of the mollusca a most interesting and fruitful one. It promises much that is new or unique.

THE HABITS OF FRESH-WATER UNIVALVES.

Most of the rivers and lakes of Indiana entirely freeze over during a considerable portion of the winter, and this fact precludes careful study of the winter habits of the univalve shells which inhabit them. Such facts as are known are meager and leave the matter in a very unsatisfactory condition. Late in the fall the shells seem to disappear from their accustomed stations, and after a week or two only those of great vitality, such as *Physa* and *Limnophysa*, are to be seen. But with the coming of frost most of these have disappeared. Whether they retire to the deeper parts of the streams and lakes, or whether they burrow deeply into the mud is not known. The large, green univalve, *Campeloma*, is now known to burrow deeply into the soft mud of the river bottoms, to reappear again in the late spring, after the waters have become fairly well warmed. The *Strepomatids* entirely disappear and nothing is known about their winter habits, but it seems probable that they bury themselves in like manner in the soft mud. With them disappear all the minute small shells like *Ammicola* and *Bythinella*. The warm, shallow banks of the larger rivers, which usually present numbers of this form, are barren of life in the winter even when dredged. What becomes of them?

Fresh-water shells, univalves, may be sought with fair hopes of success in all possible stations, but certain ones are especially rich in individuals. Crawling along half buried in the mud of sluggishly flowing streams like the Ohio, the Wabash and the White rivers, at low water, on the margins of deep water, many hundreds of *Campeloma* and *Pleurocera* may be taken. Other forms are found clinging to the surfaces of confervoid covered rocks where the waters flow swiftly, while still others, like *Physa* and *Limnophysa*, *Planorbis* and *Menetus*, may

be taken abundantly in ponds and lakes, among the reeds or clinging to them, or even floating on the surface, or rather crawling head downwards, in the still waters of river cut-offs and ponds. The minute forms may be taken in great abundance clinging to the under surfaces of lily-pads in ponds or among the masses of *Potamogeton*. Certain small forms like *Menetus exacutus* are to be taken on the submerged stems of reeds and bullrushes, or even in *Carex* swamps. Occasionally two forms are to be taken on the muddy banks of rivers, above water mark, where springs keep the surface continually wet, such forms as *Limnophysa humilis* and *Limnophysa desidiosa* being thus commonly taken. A very peculiar group of small limnæid mollusks, the *Ancyli*, will be best collected on the inner surface of dead Unios, or fresh-water mussels, in all the rivers where these mollusks abound. Frequent specimens have been taken by me adhering to the larger forms of *Pleurocera* in both the Ohio and the Wabash rivers. The stomachs of the shore forms of river fish, like *Lepomis*, or the small species found in ponds along the Wabash River, furnish many fine examples of *Ammicola* and *Bythinella*, on which they feed largely. These minute forms may be taken with a suitable small meshed dredge by scraping over the soft mud on river banks or by dredging the deeper portions of lakes and ponds. Along the Ohio and the Wabash, in the muddy pools left by the falling waters of early summer, most of the fresh-water univalves, outside the family of Limnæidæ, may commonly be found in numbers.

FRESH-WATER BIVALVES.

The large mussels are well known to all frequenters of the rivers and creeks of Indiana. They are especially abundant in the rivers and streams of the southern half of the State, though the ponds, lakes and rivers of the northern half of Indiana contain many varieties. Their presence in any portion of a river may generally be detected by broken and dead valves which lie on the river bars or are scattered along the banks; they are also found collected in heaps about muskrat burrows or on flat rocks and logs at the river's edge, having been taken there for food purposes by muskrats and raccoons. Usually deep places in rivers which have muddy bottoms furnish the larger forms, like *Unio multiplicatus*, *Unio pustulatus* and *Unio obenus*, while *Anodonta* of several species usually so abound. The habits of these animals differ very greatly. Some kinds will be found crawling around on the shallow bars or near the banks of streams, while others may be obtained only by wading and collecting in very deep water. Muddy bottoms furnish different forms from those which

delight on gravelly bars. Among the mud-loving forms are *Unio tuberculatus*, *Unio anodontoides* (= *Unio teres* Rafinesque), *Unio parvus* and its related congener, *Unio glans*. On bars which are gravelly and where the water is fairly swift, may be found in large numbers *Unio metanevrus*, *Unio pustulatus*, *Unio irroratus* and *Unio cylindricus*. In the lakes of the northern parts of the State are found but few species of Uniones, among them the lake variety of the widely distributed *Unio luteolus* and *Unio rubiginosus*, with *Margaritana rugosa*. *Unio occidentens*, usually a mud-loving species, also occurs in suitable locations in some of these northern lakes, but, like *Unio luteolus*, it is essentially a fluviatile species.

In muddy bottoms, or in stations with fine gravelly bottoms, in creeks, rivers and ponds, are to be found numbers of extremely small bivalves belonging to *Sphærium* and *Pisidium*. Ditches and small brooks will often present these forms when no others are to be taken in them. The dredge always succeeds in finding them where other methods fail. They are often mistaken for the young of the larger mussels, but needlessly so. They have no characters in common with their larger associates. One form is common in muddy stations in the Ohio which is quite white and translucent, the *Sphærium transversum* of Say.

THE ENEMIES OF MOLLUSCA.

Birds feed largely on some species of land shells, crushing the shells by a blow with the bill and extracting the soft animal readily. The bluejays strike them against rocks or other hard objects and break the shell in that manner. But field and wood mice are the great enemies of these animals. The habits of many mollusks which lead them to seek shelter under fallen logs along the margins of the forests and in woods often place them in the way of burrowing mice, who delight in them. It is no unusual thing to find hundreds of land shells with the entire top nibbled off, the animals of which have made the dinners of wood mice. Then, too, some species of land shells, notably *Macrocyelis concava*, are carnivorous and have developed cannibalistic tendencies. They push their long, slender bodies far within the unprotected apertures of the larger *Mesodons*, destroying them and eating them at their leisure. They seem to be especially fond of the epidermis of many forms, and when collected in the same box with other shells will destroy their epidermis before attacking the inmate, a habit which has rendered useless many a fine cabinet specimen, as

all collectors know. But mice and birds are the chief natural enemies of land mollusca.

Fish destroy many thousands of fresh-water mollusks of all kinds annually. The univalves are taken whole and digested as a mass by their captors. Other fish with heavy pharyngeal plates, like *Moxostoma*, or like *Aplodinotus*, crush the heavy Uniones before ingestion. In shallow creeks, where these large bivalves abound, and where hogs can reach them, they are greedily devoured by these omnivorous feeders. I have seen hogs rooting the largest of these mollusks from their beds in the rivers of the south and crushing them as they would apples, rejecting the shells and using only the soft portions. As noted above, raccoons and muskrats destroy thousands yearly, so many indeed that one wonders how they manage to perpetuate their species.

But the greatest enemy of molluscan life is man. His refuse from sewerage, factory and mill have quite depleted some rivers of this form of life for long distances or entirely. Rejectamenta from gas factories, dyeing establishments, paper mills and sawmills have annihilated these forms of life for miles. The cultivation of hillsides, otherwise favorable for land shells, the extension of farmed areas, the drainage of swamps and semi-swamps, all have had great influence in depleting the abundance of land shells. It is believed that many of the fine collecting grounds known to Say and the earlier naturalists have in this way been completely destroyed. For the land shells this is, from an economical standpoint, a matter of small moment, for none of them are directly useful to man. But with the river forms this is quite different. Many feeding grounds for fishes have been thus destroyed, and every one knows the important bearing this must have on the development of inland fisheries. Many localities once favorable to fish are now quite devoid of this form of life as a direct result of the destruction of the molluscan life. In the very largest rivers, like the Ohio, this cause is comparatively inoperative, but in rivers like the upper Wabash, the White, the Patoka and the Blue the effect is most disastrous. The embryonic forms of Unios are distributed, in one stage of their development, by fish to which they adhere; the building of dams, preventing the running of fish, has resulted in almost the complete extinction of some forms of *Unio* above them.

SPECIES DESCRIBED FROM INDIANA.

In collating the list of mollusks known from this State, it has been a matter of great interest to determine the place that furnished original habitats. The Utopian community which was founded at New Harmony had among its members some of the foremost naturalists of

America at that time. Besides Say, to whom reference has already been made, there were Owen, Troost and Maclure, all of whom contributed to the scientific status of Indiana in the earlier days. Say especially improved the opportunities afforded by the new country and described many forms from the State. After him Anthony, Conrad and Lea furnish each his quota of forms supposed to be new. The following list gives all the species thus described, and the original locality, notwithstanding that many of them are now properly recognized to be synonyms. These writers seem to have exhausted the possibilities of the State in respect to new species and varieties. The list is quite a respectable one, and if there should have been included those forms which were described by Lea from the vicinity of Cincinnati, and all which occur along the southern shores of Indiana as a part of the Ohio fauna, the list would be much larger.

LAND SHELLS.

HELICINA OCCULTA Say. Near New Harmony.

Succinea vermata Say. New Harmony.

POLYGYRA FASTIGIATA Say. New Harmony. Doubtful if from Indiana.

FRESH-WATER UNIVALVES.

ANCYLUS TARDUS Say. Wabash River.

VIVIPARA SUBPURPUREA Say. Wabash River.

CAMPELOMA PONDEROSUM Say. Ohio River.

PLEUROCERA CANALICULATUM Say. Falls of the Ohio.

Pleurocera moniliferum Lea. New Harmony.

Pleurocera anthonyi Lea. Fox River, "Indiana."

PLEUROCERA TROOSTII Lea. Near New Harmony. Locality is questionable.

LITHASIA OBOVATA Say. Wabash and Falls of the Ohio.

ANGITREMA VERRUCOSA Say. Wabash River.

ANGITREMA ARMIGERA Say. Wabash River.

Melania nupera Say. Wabash River.

=*ANGITREMA VERRUCOSA*. Wabash River.

ANCULOSA PRÆROSA Say. Falls of the Ohio.

ANCULOSA TRILINEATA Say. Falls of the Ohio.

GONIOBASIS DEPYGIS Say. Falls of the Ohio.

GONIOBASIS INTERSITA Haldeman. Swan Creek.

This species was based on specimens furnished by Mrs. Say after the death of her husband.

Goniobasis consanguinea Anthony. "Indiana."

Goniobasis bicolorata Anthony. Camp Creek, near Madison.

Goniobasis cubicoides Anthony. Wabash River.

Goniobasis infantula Lea. Falls of the Ohio.

Goniobasis louisvillensis Lea. Falls of the Ohio.

Goniobasis interlineata Anthony. Christy Creek.

Goniobasis spartanburgensis Lea. Wabash River.

Goniobasis informis Lea. Falls of the Ohio.

Goniobasis kirtlandiana Lea. "Indiana."

=*Goniobasis semicarinata* Say. Richmond.

=*Goniobasis bicolorata* Anthony. Camp Creek.

Meseschiza grosvenorii Lea. Wabash River.

This genus is now recognized to have been based upon pathologic specimens of a *Goniobasis*, probably *Goniobasis cubicoideus* Anthony. The specimens were not only pathologic, but immature. The writer has several times, in streams in the South, noted many specimens of traumatic shells which might easily be referred to this "genus."

FRESH-WATER BIVALVES.

Unio abruptus Say. Wabash River.

UNIO ORBICULATUS Hildreth.

Unio arquatus Conrad. Wabash River.

=UNIO RECTUS Lamarck. Pathologic.

Unio capillus Conrad. Wabash River.

=UNIO FABALIS Lea. Ohio River.

Unio cicatricosus Say. Wabash River.

=UNIO VARICOSUS Lea.

UNIO CYLINDRICUS Say. Wabash River.

UNIO ELEGANS Lea. Wabash and Ohio rivers.

Unio heros Say. Wabash River.

=UNIO MULTIPLICATUS Lea.

UNIO MYTILOIDES Rafinesque. Wabash River.

UNIO PERSONATUS Say. Wabash River.

Unio phillipsii Conrad. Wabash River.

Unio sampsonii Lea. Wabash River.

=UNIO PERPLEXUS Lea.

UNIO SECURIS Lea. Ohio and Wabash rivers.

UNIO SULCATUS Lea. Wabash and Ohio rivers.

UNIO UNDULATUS Barnes. Wabash River.

MARGARITANA CONFRAGOSA Say. Wabash River.

MARGARITANA DEHISCENS Say. Wabash River.

=*Unio dehiscens* Say.

MARGARITANA MONODONTA Say. Wabash and Ohio rivers.

=*Unio monodonta* Say. From Falls of the Ohio.

ANODONTA EDENTULA Say. "Indiana." Locality not given.

Anodonta ferruginea Lea. Simon's Creek.

ANODONTA IMBECILLIS Say. Wabash River.

ANODONTA SUBORBICULATA Say. Ponds near Wabash River.

Of this list those species which are now believed to be synonyms are printed in *italics*. Of them it will be found that one writer has described the greater number, which fact is not surprising when one knows that Mr. Lea described as new everything which came from different streams or from beyond the borders of different states. Political State boundaries appear to have been, in Mr. Lea's mind,

insuperable obstacles to the distribution of species. Even eliminating these from our lists, there will yet remain a respectable number first made known to science from Indiana.

GEOGRAPHIC DISTRIBUTION OF FRESH-WATER FORMS.

The following summary tables of distribution of the fresh-water forms have been prepared, which will exhibit at a glance all the known facts in distribution at the present time. Sufficiently full collections of the land shells have not been made to warrant the preparation of similar tables for that division. The hydrographic map (Plate I) exhibits the drainage areas employed as best showing the distribution of the fresh-water forms.

SUMMARY OF GEOGRAPHIC DISTRIBUTION.

FRESH-WATER FORMS.

SPECIES.	Ohio Basin.	Whitewater Basin.	Patoka Basin.	East White Basin.	West White Basin.	Wabash Basin.	Maumee Basin.	St. Joseph Basin	Kankakee Basin.	Lake Michigan Basin.
UNIVALVES.										
<i>Amnicola cincinnatiensis</i> Anth.	×									
<i>Amnicola limosa</i> Say	×	×								
<i>Amnicola porata</i> Say	×	×	×	×	×	×	×	×	×	×
<i>Ancylus tardus</i> Say	×	×					×	×	×	
<i>Bulinus hypnorum</i> Linneus.					×	×	×	×	×	×
<i>Helisoma bicarinata</i> Say		×			×		×	×	×	
<i>Helisoma campanulata</i> Say										
<i>Helisoma trivoltris</i> Say	×	×	×	×	×	×	×	×	×	×
<i>Limnophysa caperata</i> Mull					×	×	×	×	×	×
<i>Limnophysa desuliosa</i> Say	×	×			×	×	×	×	×	×
<i>Limnophysa humilis</i> Say	×	×	×	×	×	×	×	×	×	×
<i>Limnophysa palustris</i> Mull	×	×	×	×	×	×	×	×	×	×
<i>Limnophysa reflexa</i> Say	×	×	×	×	×	×	×	×	×	×
<i>Menetus exacutus</i> Say				×	×	×	×	×	×	×
<i>Physa ancillaria</i> Say										
<i>Physa gyrina</i> Say	×	×	×	×	×	×	×	×	×	×
<i>Physa heterostropha</i> Say	×	×	×	×	×	×	×	×	×	×
<i>Valvata tricarinata</i> Say								×		
<i>Somatogyrus subglobosus</i> Say	×	×								
<i>Pomatopsis lapidaria</i> Say	×				×	×	×	×		
<i>Campeloma decium</i> Say										
<i>Campeloma integrum</i> DeKay					×	×	×	×		×
<i>Campeloma ponderosum</i> Say	×					×	×	×		
<i>Campeloma rufum</i> Hald				×	×	×	×	×		
<i>Campeloma subsolidum</i> Anth.					×	×	×	×	×	
<i>Lioplax subcarinata</i> Say	×									
<i>Vivipara concoloroides</i> Binney								×		
<i>Vivipara intertexta</i> Say						×	×	×		
<i>Vivipara subpurpurea</i> Say						×	×	×		
<i>Anculosa prerosa</i> Say	×									
<i>Anculosa trilineata</i> Say	×									
<i>Anculosa carinata</i> Brug	×									
<i>Angitrema armigera</i> Say						×	×	×		
<i>Angitrema verrucosa</i> Say						×	×	×		
<i>Goniobasis bicolorata</i> Anth	×									
<i>Goniobasis cubicooides</i> Anth	×					×	×	×		
<i>Goniobasis depygii</i> Say	×									
<i>Goniobasis infantula</i> Lea	×									
<i>Goniobasis informis</i> Lea	×									

SUMMARY OF GEOGRAPHIC DISTRIBUTION—Continued.

SPECIES.	Ohio Basin.	Whitewater Basin.	Pataoka Basin.	East White Basin.	West White Basin.	Wabash Basin.	Maumee Basin.	St. Joseph Basin.	Kankakee Basin.	Lake Michigan Basin.
UNIVALVES.										
<i>Goniobasis interlineata</i> Anth.	×	×								
<i>Goniobasis intersita</i> Hald.	×									
<i>Goniobasis licescens</i> Menke	×					×	×	×		×
<i>Goniobasis louisvillensis</i> Lea.	×	×								
<i>Goniobasis semiscarinata</i> Say		×								
<i>Goniobasis spartanburgensis</i> Lea	×	×	×	×	×	×	×	×	×	×
<i>Goniobasis pulchella</i> Anth.	×	×								
<i>Likasia obovata</i> Say	×									
<i>Mesochiza prolesmorii</i> Lea	×									
<i>Pleurocera canaliculatum</i> Say.	×	×			×	×	×	×		
<i>Pleurocera elevatum</i> Say	×					×				
<i>Pleurocera montiferum</i> Lea	×					×				
<i>Pleurocera simplex</i> Lea	×						×			
<i>Pleurocera subulare</i> Lea	×					×	×		×	×
<i>Pleurocera troostii</i> Lea	×					×				
<i>Pleurocera undulatum</i> Say	×					×				
BIVALVES.										
<i>Pisidium abditum</i> Hald.	×				×	×	×	×	×	
<i>Pisidium rotundatum</i> Prime	×							×	×	
<i>Pisidium virginicum</i> Bourg.	×							×	×	
<i>Sphaerium fabale</i> Prime						×		×	×	
<i>Sphaerium rhomboides</i> Prime.	×	×	×	×	×	×	×	×	×	×
<i>Sphaerium solidulum</i> Prime	×	×	×	×	×	×	×	×	×	×
<i>Sphaerium sphaericum</i> Anth.	×	×				×	×	×	×	
<i>Sphaerium stansineum</i> Conrad.	×	×				×	×	×	×	
<i>Sphaerium striatinum</i> Lam	×	×	×	×	×	×	×	×	×	×
<i>Sphaerium sulcatum</i> Lam	×	×				×	×	×	×	
<i>Sphaerium transversum</i> Say	×	×	×	×	×	×	×	×	×	?
<i>Anodonta decora</i> Lea	×	×	×	×	×	×	×	×	×	×
<i>Anodonta edentula</i> Say	×	×	×	×	×	×	×	×	×	×
<i>Anodonta ferruginea</i> Lea	×	×	×	×	×	×	×	×	×	×
<i>Anodonta ferrussaciana</i> Lea	×	×	×	×	×	×	×	×	×	×
<i>Anodonta footiana</i> Lea	×	×	×	×	×	×	×	×	×	?
<i>Anodonta grandis</i> Say	×	×	×	×	×	×	×	×	×	?
<i>Anodonta imbecillis</i> Say.	×	×				×				
<i>Anodonta parvona</i> Lea	×	×	×	×	×	×				
<i>Anodonta plana</i> Lea	×	×				×		×		
<i>Anodonta salmonea</i> Lea	×					×		×		
<i>Anodonta shefferiana</i> Lea.	×					×		×	×	
<i>Anodonta subquadrata</i> Lea.	×					×		×	×	
<i>Anodonta wartiana</i> Lea	×			×	×	×				
<i>Anodonta suborbiculata</i> Say.	×					×				
<i>Anodonta undulata</i> Say	×					×		×		
<i>Margaritana calcicola</i> Lea	×	×	×	×	×	×	×	×	×	?
<i>Margaritana complanata</i> Bar.	×	×				×		×		
<i>Margaritana contragosa</i> Say	×					×		×		
<i>Margaritana delvicens</i> Say	×					×		×		
<i>Margaritana hildrethiana</i> Lea	×	×		×	×	×		×		
<i>Margaritana marginata</i> Say	×	×	×	×	×	×	×	×	×	?
<i>Margaritana monodonta</i> Say	×	×	×	×	×	×	×	×	×	×
<i>Margaritana rugosa</i> Barnes	×	×	×	×	×	×	×	×	×	×
<i>Unio abruptus</i> Say	×					×		×		
<i>Unio cyphus</i> Raf	×					×		×		
<i>Unio alatus</i> Raf	×			×	×	×		×		
<i>Unio anodontoides</i> Lea	×					×		×		
<i>Unio arctor</i> Lea	×					×		×		
<i>Unio asperimus</i> Lea	×			×	×	×		×		
<i>Unio camptodon</i> Say	×	×				×		×		
<i>Unio capax</i> Green	×					×		×		
<i>Unio cicatricosus</i> Say	×					×		×		
<i>Unio cincinnatensis</i> Lea	×					×		×		
<i>Unio circulus</i> Lea	×			×	×	×		×		
<i>Unio clovus</i> Lam	×	×	×	×	×	×	×	×		?
<i>Unio rostratus</i> Lea	×			×	×	×		×		
<i>Unio cooperianus</i> Lea.	×					×		×		

SUMMARY OF GEOGRAPHIC DISTRIBUTION—Continued.

SPECIES.	Ohio Basin.	Whitewater Basin.	Patoka Basin.	East White Basin.	West White Basin.	Wabash Basin.	Maumee Basin.	St. Joseph Basin.	Kankakee Basin.	Lake Michigan Basin.
BIVALVES.										
<i>Unio cornutus</i> Barnes	XXX			X	X	XXX			X	
<i>Unio crassidens</i> Lam										
<i>Unio cylindricus</i> Say	XXX			X	X					
<i>Unio distans</i> Anth								X		
<i>Unio donaciformis</i> Lea	XXX			X	X	X				
<i>Unio dorfeuilianus</i> Lea	XXX									
<i>Unio ebenus</i> Lea	XXX					XXX				
<i>Unio elegans</i> Lea	XXX			XX	XX	XXX			XX	
<i>Unio elliptis</i> Lea	XXX	X	X	XX	XX	XXX	X	XX	XX	X
<i>Unio fabalis</i> Lea	XXX							XX		
<i>Unio foliatus</i> Hild	XXX							XX		
<i>Unio fragosus</i> Conrad	XXX									
<i>Unio gibbosus</i> Barnes	XXX	X	X	XX	XX	XXX	XX	X	X	X
<i>Unio glans</i> Lea	XXX			XX	XX	XXX				
<i>Unio gracilis</i> Barnes	XXX									
<i>Unio graniferus</i> Lea	XXX									
<i>Unio iris</i> Lea	XXX	X	X	XXX	XXX	XXX	X	X	X	X
<i>Unio irroratus</i> Lea	XXX			XXX	XXX	XXX				
<i>Unio lachrymosus</i> Lea	XXX	X		XXX	XXX	XXX			X	
<i>Unio laevissimus</i> Lea	XXX									
<i>Unio lens</i> Lea	XXX									
<i>Unio ligamentinus</i> Lea	XXX	XX		XX	XX	XXX	XX	XX	XX	XX
<i>Unio luteolus</i> Lam	XXX	XX	XX	XXX	XXX	XXX	XX	XX		XX
<i>Unio metaneurus</i> Raf	XXX			XX	XX	XXX				
<i>Unio multiradiatus</i> Lea	XXX	XX	X	XXX	XXX	XXX	XX	X	XXX	X
<i>Unio multiplicatus</i> Lea	XXX	XX		XX	XX	XXX	XX	X	XXX	X
<i>Unio mytiloides</i> Raf	XX									
<i>Unio nasutus</i> Say	XXX							X		
<i>Unio obliquus</i> Lam	XXX									
<i>Unio occidentis</i> Lea	XXX	X	X	X	X	XXX	X	X	X	X
<i>Unio orbiculatus</i> Hild	XXX	X	X	X	X	XXX	X	X	X	X
<i>Unio ovatus</i> Say	XXX									
<i>Unio parvus</i> Barnes	XXX	X	X	XX	XX	XXX	X	X	X	
<i>Unio perplexus</i> Lea	XXX									
<i>Unio personatus</i> Say	XXX									
<i>Unio phaseolus</i> Barnes	XXX									
<i>Unio plenus</i> Lea	XXX			X	X	XXX	X	X	X	
<i>Unio plicatus</i> LeSueur	XXX									
<i>Unio pressus</i> Lea	XXX	XX	XX	XX	XX	XXX	X	X	XX	X
<i>Unio pustulatus</i> Lea	XXX									
<i>Unio pustulosus</i> Lea	XXX						X			
<i>Unio pyramidatus</i> Lea	XXX									
<i>Unio rangianus</i> Lea	XXX									
<i>Unio rectus</i> Lam	XXX	X	XX	XX	XX	XXX	X	X	X	X
<i>Unio retusus</i> Lam	XXX			XX	XX	XXX				
<i>Unio rubiginosus</i> Lea	XXX	X	XX	XX	XX	XXX	XX	X	X	X
<i>Unio sampsoni</i> Lea	XXX									
<i>Unio securis</i> Lea	XXX				X	XXX				
<i>Unio solidus</i> Lea	XXX									
<i>Unio spatulatus</i> Lea	XXX			X	X	XXX				
<i>Unio subovatus</i> Lea	XXX									
<i>Unio subrostratus</i> Say	XXX						X		XX	
<i>Unio sulcatus</i> Lea	XXX									
<i>Unio tenuissimus</i> Lea	XXX									
<i>Unio triangularis</i> Barnes	XXX			X	X	XXX				
<i>Unio trigonus</i> Lea	XXX									
<i>Unio tuberculatus</i> Barnes	XXX	XX	XX	XX	XX	XXX			XX	
<i>Unio undulatus</i> Barnes	XXX	XX	XX	XX	XX	XXX			XX	
<i>Unio varicosus</i> Lea	XXX						X	X		X
<i>Unio ventricosus</i> Barnes	XXX									
<i>Unio verrucosus</i> Barnes	XXX								XX	
<i>Unio zigzag</i> Lea	XX			X	X	XX				X
Totals	127	47	37	61	81	131	49	59	63	35

The ten drainage basins which are represented in these tables cover the entire State, and the tables afford a fairly reliable statement of the distribution of fresh-water forms over Indiana. It is interesting to note that this distribution appears to have some relation to the existence of the moraines of the Glacial Epoch and to have been in some definite sense determined thereby. This evidence has been elsewhere considered,* and I need not now stop to refer to it in detail. Northwards of this ancient ice barrier many southern forms have not yet succeeded in establishing themselves; but south of it many southern species of *Strepomatidæ* and *Unionidæ* are known to occur, though their metropolis is farther to the south within the borders of Tennessee and Alabama. A few forms are distributed over the entire State, a list of which is herewith presented:

REGISTER OF GENERALLY DISTRIBUTED SPECIES.

<i>Unio clavus.</i>	<i>Unio ellipsis.</i>
<i>Unio iris.</i>	<i>Unio pressus.</i>
<i>Unio luteolus.</i>	<i>Unio gibbosus.</i>
<i>Unio ligamentinus.</i>	<i>Unio rectus.</i>
<i>Unio multiradiatus.</i>	<i>Unio occidentis.</i>
<i>Unio rubiginosus.</i>	<i>Margaritana calceola.</i>
<i>Margaritana marginata.</i>	<i>Margaritana rugosa.</i>
<i>Anodonta ferussaciana.</i>	<i>Anodonta edentula.</i>
<i>Anodonta grandis.</i>	<i>Sphaerium solidulum.</i>
<i>Sphaerium striatinum.</i>	<i>Sphaerium transversum.</i>
<i>Amnicola porata.</i>	<i>Amnicola limosa.</i>
<i>Limnophysa palustris.</i>	<i>Limnophysa reflexa.</i>
<i>Limnophysa desidiosa.</i>	<i>Helisoma trivolvis.</i>
<i>Physa heterostropha.</i>	<i>Physa gyrina.</i>
<i>Goniobasis pulchella.</i>	

These species are among the most common in North America, and most of them have a very wide range indeed. They are mostly hardy species and though subjected to a great variety of stations and environmental conditions do not appear to have suffered much individual variation, none of the species being critical ones, that is, forms which are with difficulty recognized. All present a strongly characteristic facies and all are easily determined, no matter from what portion of the State they may come.

A further study of the geographical tables will demonstrate that the richest shell faunas occur in the Wabash and the Ohio drainages, these two areas furnishing nearly the same species in common, though many of each are not generally distributed over the State. Of the shells which are both common and yet limited in distribution *Unio*

*See Proceedings Indiana Academy of Science, for 1896, pp. 248 et seq.

ebenus, *Unio irroratus* and *Unio cyphia*, among the bivalves, and *Campeloma ponderosum* and *Pleurocera canaliculatum*, among the univalves, will serve as types. The differences between the two basins may be noted from the following lists, in which synonyms appear in small capitals:

OHIO BASIN.

UNIO CAMELUS.
Unio varicosus.
 UNIO CININNATIENSIS.
Unio foliatus.
Unio dorfeullianus.
Sphaerium stamineum.
Anculosa prerosa.
Anculosa trilineata.
Anculosa carinata.
 GONIOBASIS BICOLORATA.
Goniobasis depygis.
 GONIOBASIS INFANTULA.
 GONIOBASIS INFORMIS.
Goniobasis intersita.
 GONIOBASIS LOUISVILLENSIS.
 PLEUROCERA SIMPLEX.
Ammicola cincinnatiensis.

WABASH BASIN.

Unio personatus.
 UNIO SAMPSONII.
Anodonta suborbiculata.
Margaritana confragosa.
Sphaerium sphaericum.
 **Sphaerium fabale.*
 GONIOBASIS SPARTENBURGHENSIS.
Goniobasis livescens.
Goniobasis cubicoides.
Angitrema armigera.
 MESECHIZA GROVESNORII.
Pleurocera troostii. Doubtful.
Vivipara subpurpurea.
Vivipara contectoides.
Vivipara intertexta.
Menetus exacutus.
Campeloma decisum.
Campeloma ruyum.
Campeloma subsolidum.
Limnophysa caperata.
Planorbella campanulata.

Here is a total of eleven species found in the Ohio basin against fifteen which are found in the Wabash basin. The proportion would be substantially the same if the synonymous forms included, printed in small capitals, were not excluded from the list. None of the members of the genus *Vivipara* appear in the Ohio basin, while but two *Uniones* are found in the Wabash Basin that are not found in that of the Ohio. No limnæids appear to be characteristic of the Ohio basin, while three such are found in the Wabash. Yet it is to be constantly borne in mind that further collections may invalidate this comparison by the discovery of other common forms, or that some of these forms may yet be ascertained to be common to the two faunas.

Turning again to the northern portion of the State, the most interesting fact presented is the existence of a number of Ohio drainage forms in the Maumee River, a stream of the Atlantic drainage. Opportunity was afforded the writer, in 1895, to make a small collec-

*Not seen; admitted to the list on the authority of Temple Prime, vide "Catalogue of the Species of Corbiculadæ," p. 10, 1863.

tion in the Maumee and the St. Mary's rivers, at Fort Wayne, well within the Maumee basin. While the collection was by no means exhaustive, it developed some very interesting facts which possess more than a passing significance.

Among the Ohio River forms found were the following:

<i>Unio rubiginosus.</i>	<i>Unio clavus.</i>
<i>Unio glans.</i>	<i>Unio gibbosus.</i>
<i>Unio luteolus.</i>	<i>Unio parvus.</i>
<i>Unio retusus.</i>	<i>Unio pressus.</i>
<i>Margaritana complanata.</i>	<i>Margaritana calceola.</i>
<i>Anodonta edentula.</i>	<i>Goniobasis pulchella.</i>

These species are accredited to the Western fauna, and most of them are not hitherto recorded as belonging to the Atlantic fauna. Two of these were so recorded by the writer as long ago as 1877, in the Erie Canal, in the Mohawk drainage, at Mohawk, N. Y., and record made of the fact in the "American Naturalist," Vol. XII, pp. 472, 473. Other records have since appeared. *Unio luteolus* is often quoted in faunal lists used for exchange purposes by Eastern collectors, but in every case where specimens have been secured, thus far, they have proven to be the male forms of the totally distinct *Unio cariosus*, a form not yet found in Western waters. *Anodonta edentula* may be, and probably is, a geographic variety of the Eastern *Anodonta undulata*, but the Maumee forms are Western in facies. It is therefore proper to regard it here as a Western shell in the drainage of an Atlantic stream. So far as the specimens go which are in my possession, they do not present very marked differences from the same shells found a few miles to the west in waters tributary to the Wabash. The environmental factors are precisely the same in both areas, and there should be no marked differences. There are none. But mingling with the Western fauna of the Upper Wabash were found large numbers of the Eastern strepomatid shell, *Goniobasis livescens*, a form which is abundant from New York throughout northern Ohio and along the Great Lakes. Near Huntington, on the Wabash, this shell was the most abundant strepomatid found. The same facts were true of the St. Mary's and the Maumee, though the greatest numbers were found in the former stream, clinging to the rocks along the banks, in the heart of the city of Fort Wayne. Associated with them were large numbers of *Pleurocera subulare*, a form abundant in the East, but also of wide Western distribution, and an undetermined pleuroceroid mollusk of Western affinities. It closely resembles *Pleurocera lewisii*, but of this determination I am yet uncertain.

It is important to note, in this connection, that the headwaters of the Aboite River, or its east fork, approach to within three miles of the St. Mary's at Fort Wayne, and that the divide at that locality is barely perceptible. Moreover, the Wabash and Erie Canal has long established water communication between the two basins—probably long enough to establish interchange of faunas, especially in the case of the univalves, which are far more migratory in their habits than the Unionidæ. This is the case in the Erie Canal in New York, by means of which the advent of the Western faunas into Eastern waters may be almost chronologically traced. To offset this possible explanation, is the fact that the species seem to be well established, and occur, many of them, in great numbers in the Maumee Basin. But, whatever the explanation, the species appear in the two basins, and in them both there is a commingling of the two faunas, with but few Western representatives of the Eastern fauna. The Western representatives in the Eastern fauna greatly outnumber, both in species and individuals, the Eastern fauna in the Western Basin.

The suggestion of the relation of this distribution to glaciation and its physiographic results has before occurred to the writer, though in another connection. As long ago as 1886, in discussing certain anomalies in the distribution of Ohio River forms of *Unionidæ* in the State of Kansas, attention was directed to this problem in the following language: "Considerable data have accumulated in the hands of the writer which seem to imply the necessity of correlating this peculiar distribution with certain facts in glacial geology, but those data will not warrant the statement that such correlation exists. Attention is directed to this problem in the hope that other observers may use their opportunities and supply all the information possible."* A recent writer proposes,** the same explanation for the distribution of the two faunas in this region and, from the facts we have herein adduced, the locality offers most excellent opportunities for a careful study of the problem. Yet, the fact of the artificial connection of these two areas must constantly be borne in mind. A second region where the heads of the drainage areas are practically coincident occurs in Kosciusko County, where the several small lakes and general low-lying region are all drained by streams which flow either into the Tippecanoe or the Turkey rivers, the first of which is tributary to the Wabash, the second to the St. Joseph, of Michigan. A low moraine separates the two basins.

*Vide, Call, "Fifth Contribution to a Knowledge of the Fresh-water Mollusca of Kansas," Bull. Washburn College Laboratory of Natural History, vol. i, No. 6, pp. 178, 179, 1886.

**Simpson, "On the Mississippi Valley Unionidæ Found in the St. Lawrence and Atlantic Drainage Areas," American Naturalist, vol. xxx, pp. 379-384, 1896.

THE ECONOMIC USES OF INDIANA MOLLUSCA.

To what extent, if any, the former inhabitants of Indiana used these animals for food purposes can never be known. In many instances the aborigines made some use of the larger forms of mussels, as is abundantly witnessed by the shells found in mounds and in piles on the sites of ancient villages. But it is mere guess that they formed any considerable part of their food. The interiors of many species are highly colored and very beautiful, and this fact may have appealed to the primitive inhabitants of Indiana. Near the village of Lawrenceburg, Dearborn County, in the great triangular plain formed by the junction of the Miami and the Ohio rivers, are several large mounds, now well worn down by cultivation, in which thousands of these shells are still to be seen. It is certain that there is no historic record of their use by the red men for food. But there is no good reason why, with abundance of condiment and proper preparation, a really serviceable food article could not be made out of them. The large white "foot" is tough, and becomes more so when well cooked, but many of the smaller shells have a tender animal which could be eaten, if necessary. Trial attempts made by the writer to use these as food show that they are better than common report makes them.

But two economic uses for these shells are now known. One of these is the manufacture of a good grade of pearl button, an industry which is prosecuted with some success at Muscatine, Iowa, where there are large button factories. The great possibility that pertains to these animals in this direction can be best appreciated by those who know their habits and know of the immense beds, miles in length, in the Mississippi and other large rivers. The shells are easily taken by dredging with steam dredges, and the thick disks of certain species made into button blanks, to be perforated and finally polished. Many gross are thus annually made. In rivers like the Wabash and the Ohio, where the writer knows of *Unio* beds miles in length, enormous quantities of these animals may be found as raw material. Not all the forms in Indiana rivers are suitable for this purpose, but many thousands of bushels may be obtained which are entirely suitable.

Throughout the Northwest, and even into the Southern States, a few years ago, swept a pearl-hunting craze which has resulted in the loss of thousands of these animals in an uncertain search for pearls. One who has long studied these animals soon comes to know the forms which commonly produce pearls and how they are formed. In every case of a pearl forming it marks a pathologic condition of the animal. Usually the introduction of some foreign matter, like small

gravel grains or sand or other object, is a sufficient irritation to the shell-forming portion, the mantle, and the animal seeks to cover over the intrusion with a layer of pearl. Often the object remains detached from the shell; often it is cemented to the inner face of the valve as an excrescence. In this way the pearls begin to be formed. Most of them are irregular in shape and often lack the lustre which gives them the value of gems. But they are by no means uncommon in certain species. In the Raccoon River, in Iowa, occurs a species, *Unio wardii*, which is closely related to *Unio metanevrus*, so common in the Ohio and Wabash rivers of Indiana. It is rare indeed to find an individual of this species, and they are numerous, which does not contain from one to three or four pearls, of varying sizes. The writer has had, at times, as many as two hundred pearls taken from this species alone. Observation has shown that the large, heavy forms which live on gravel bars in swiftly running waters produce most of these objects. It would appear that under these conditions small sand grains which act as a nucleus are swept into the body of the shell and are the prime cause of the pearl formation. Some species never produce them, at least they have never appeared in the course of over twenty years of collection and study of these forms. Among these are those forms which live in mud and in deep and sluggishly flowing waters.

Mr. George F. Kunz has placed on record* about all that is known of the "pearl-hunting industry" and its results in this country. It is hardly in such condition as to warrant the name of "industry," being carried on spasmodically and without any very scientific or business-like methods. Occasionally pearls of excellent quality have been found, and for them good prices have been obtained, Mr. Kunz reporting that two large pearls from Florida brought \$850 and \$600, respectively. Many of lesser value have been taken in various parts of the United States, notably in Tennessee, Wisconsin and Iowa, but it is not yet an "industry," and with the present grade of intelligence employed in its prosecution is not likely to become such. The usual employments for embellishment and for jewelry purposes common to the pearls of the Orient are also made of these fresh-water forms.

The use of the soft inmate of *Unio* shells for bait for fishing purposes destroys many and gives an additional small economic use for these animals. In the earlier days the shells were sometimes burned for lime making, but this has long since been abandoned. Their chief value now is as food for fishes and for the manufacture of buttons, as above noted. In some places, especially about the summer

*The Fresh-water Pearls and Pearl Fisheries of the United States. Bulletin U.S. Fish Commission, 1897, pp. 373-426, 1898.

resorts of the West and South, *Unio* shells are polished, the epidermis being entirely removed and the polished shells mounted as pincushions and cardcases, making very attractive and useful souvenirs. Some species, like *Unio coccineus*, *Unio crassidens* and *Unio purpuratus*, have exceedingly rich nacles of light or dark purple and warm pink, which take a high polish and make very rich ornaments. But this industry is fitful and as yet in unskilled hands. What could be done with these shells by people of mechanical skill who understand the weaknesses of human nature for ornamentation can only be surmised.

THE NOMENCLATURE ADOPTED IN THIS CATALOGUE.

There have been several attempts of late to devise new systems of classification for nearly all the groups of American land and fresh-water mollusks, most of which have little besides novelty to compel acceptance. It has been the bane of natural history studies that "closet naturalists" periodically get to work on well-known groups and propose something new in the way of classification. Indiana shells have proven no exception to this rule. It has been a matter of some concern to us just how to approach this phase of our task. A coterie of Philadelphia naturalists have recently proposed a new system of classification for American land shells which is little, if any, less novel than one proposed many years ago by Tryon, also of Philadelphia. But the proposed system does such violence to natural affinities, and brings together in single groups such widely different species of mollusks, that we are unable to accept the scheme proposed. It were as well to accept the Linnean genus *Helix* and place everything under it as to accept *Polygyra*, now done in some sections, and put about everything under it. These ephemeral schemes of grouping but render more difficult any correct understanding of our forms; they are intended to be helpful, but really interpose almost insuperable difficulties. About once in a decade some of these "genus jugglers" get to work at natural groups and when they are through with them little that is familiar is left.

The system adopted in this catalogue is that of W. G. Binney, as set forth in his later publications. His "Manual of American Land Shells" has been made the basis of our work, as containing, in all respects, the most scientific and best treatment of these forms, though one can not always agree with his opinions in the matter of synonymy. But his classification is, in most respects, very natural and quite satisfactory.

In the matter of the *Unionidæ* there has also been a recent attempt to divide this great group into subgenera which certainly have no

existence in nature. Species of the widest differences are brought together in a single subgenus, and most violent adjustments have been attempted. For these subgroups it has been attempted to recognize the names proposed long ago by Rafinesque, a procedure which would be right if, first, the groups really existed in nature, and if, second, any one now knew more than three or four of Rafinesque's species and the subgenera he founded on them. Many years ago Agassiz attempted this same treatment, and was followed by Stimpson, in his "Testaceous Shells of New England," but the attempt was so unnatural that it speedily found its place in the limbo of neglected genius. Very recently Baker, following Simpson, in his "Mollusca of the Chicago Area; The Pelecypoda," has attempted to recognize these Rafinesquian names, and some remarkable groupings of forms, unknown in nature, have been attempted. Thus the subgenus *Quadrula* is made to cover all forms like *Unio trigonus*, and also includes the totally different forms of shells that may be typified by *Unio plicatus*. It is very difficult to conceive that such systems are proposed in sober seriousness. We are promised a fuller exposition of these anomalous classifications later on.

There are recognized in this catalogue the three long and well-known subgenera of *Anodonta*, *Margaritana* and *Unio*. Not only are these names altogether familiar to American students, but they really represent natural divisions of the pelecypod mollusca of this country. Not only are their conchologic distinctions clearly indicated by this grouping, but after more than twenty years of study of this group, as a particular object, during which time all the known species have passed in review, there have been found embryologic reasons for accepting this time-honored classification. It should be remembered by the student that novelty is not alone a sufficient reason for acceptance. There are so many forms of the *Unionidæ* now known that exceptional difficulty is experienced in identification of critical forms, but when one remembers that many synonyms exist, these difficulties resolve themselves into specific identities rather than in systems of classification. So, in recognizing genera or subgenera, in the *Unionidæ* the writer declines to follow the lead of these recent writers, as tending to "worse confound confusion," and allows the three long honored subgroups to stand.

In the matter of the *Corbiculadæ*, which have not escaped the systematists, I have followed Prime's Monograph of that group, as presented in the Smithsonian Institution's publications, and later in the "Annals of the New York Lyceum of Natural History." Later writers have described many new forms, most or all of which are

based upon the young and immature specimens of well-known forms. Many of these have been presented through the pages of the "Nautilus," a paper devoted to the interests of amateur conchologists and published in Philadelphia. Careful study of the facts of geographic distribution and the descriptions together will convince any but those who trade in species for the purpose of enriching their own cabinets that the already extensive synonymy of this family is being greatly augmented. We recognize but the two genera *Spharium* and *Pisidium*, because we believe other recently recognized groups are fictitious and find no expression in nature.

Since this catalogue is designed not to present the classification of Indiana mollusca, but as a means of becoming acquainted with the shell fauna of the State, all questions of classification have been eliminated and well-known names only have been employed. The classification adopted is one generally accepted.

THE LITERATURE OF INDIANA MOLLUSCA.

The books, papers, memoirs and published notes which deal with the mollusca of Indiana are considerable in number. It is largely due to the long residence at New Harmony of Say that so many papers appeared. for his personal work directed the attention of many students to the richness of this fauna. These papers cover all branches of conchologic science, from original descriptive papers to those which deal with local or general distribution problems. The list accompanying this paper, made up wholly from private resources, is practically complete, few if any papers existing which will be helpful to students of Indiana mollusca that are not included. The arrangement of titles is by authors, alphabetically, and then in chronological order under each writer. In most cases some mention of the ground covered has been included with the title, but the limits of this report precluded a full resume of contents. It has been our aim to present titles of all literature which the special student of the State's fauna must consult to fully understand the nature of the problems with which he will be confronted.

Anonymous. (Investigator.) Remarks on the article contained in Silliman's Journal for April, 1832, entitled, "Mr. Lea on the Naiades," by Investigator. Monthly American Journal of Geology and Natural Science. Vol. I, No. 8, pp. 370-377, 1832.

Anonymous. Catalogue of the Unios, Alasmodontas and Anodontas of the Ohio River and its Northern Tributaries, Adopted by the Western Academy of Natural Sciences of Cincinnati, January, 1849.

There are listed in the 19 pages of this rare little brochure 56 species of *Unio*, six of *Margaritana* and five of *Anodonta*. The catalogue is remarkable as being the first open expression of hostility to both the claims of Say and of Rafinesque. It marks the beginning of a long and bitter controversy, from the effects of which American malacology has not yet fully recovered.

Anthony, J. G. Descriptions of New Melanians. Proceedings of the Boston Society of Natural History, Vol. III, pp. 361-363, 1850.

Contains descriptions of a number of Indiana forms.

Anthony, J. G. Descriptions of New Fluvial Shells of the Genus *Melania* of Lamarck from the Western States of North America. Annals of the New York Lyceum of Natural History, Vol. VI, pp. 83-129, March, 1854.

Baker, Frank Collins. The Mollusca of the Chicago Area. The Pelecypoda. Bulletin No. III, Chicago Academy of Sciences, pp. 1-130, plates i-xxvii, 1898.

This is a valuable paper, but it is not well illustrated; the process employed fails to bring out the characters of the several shells. The synonymy adopted for the *Unionidæ* is taken almost entirely from Call's Arkansas Report.

Barnes, D. H. On the Genera *Unio* and *Alasmodonta*; with Introductory Remarks. American Journal of Science and Art, First Series, Vol. VI, No. 1, pp. 107-127; No. 2, pp. 258-280, 1823.

This is a very valuable paper since it contains Barnes's original descriptions and figures of Ohio and Indiana shells.

Barnes, D. H. Reclamation of Unios. American Journal of Science and Art, First Series, Vol. XIII, No. 2, pp. 358-364, 1828.

Binney, Amos. The Terrestrial Air-Breathing Mollusca of the United States, and the Adjacent Territories of North America. Vols. I, II (text), 1851; Vol. III (plates), 1857.

This work is now very rare, but is yet indispensable to all workers in land mollusca. The anatomy of many species was worked out by Dr. J. Leidy, and is illustrated with many beautiful plates.

Binney, W. G. The Complete Writings of Thomas Say on the Conchology of the United States, 1858.

Dr. Binney has collected in this volume all of Say's papers, with reproductions of his plates, from the early articles in Nicholson's Encyclopedia to his latest work.

Binney, W. G. Supplement to the Terrestrial Mollusca of North America. Boston Journal of Natural History, Vol. VII, pp. 6-196, 1859.

Brings down to that date, 1859, the work of the elder Binney, with plates of the new forms described. Very rare; was published, separately, from oversheets, as Vol. IV of the Terrestrial Mollusca.

Binney, W. G. Check-list of the Shells of North America. Terrestrial Gasteropoda. Washington, 1860; second edition.

List Number II of this title is general for that portion of the United States which includes Indiana.

Binney, W. G. Land and Fresh-water Shells of North America. Part 1, Pulmonata Geophila. Smithsonian Misc. Coll., No. 194, 1869.

This is the earliest of Binney's series to be out of print, and is now rare. It covers the land mollusca of North America very fully, with illustrations of all the forms to be found in Indiana.

Binney, W. G. Land and Fresh-water Shells of North America. Part II, Pulmonata Limnophila and Thallasophila. Smithsonian Misc. Coll., No. 143, 1865.

Binney, W. G. Land and Fresh-water Shells of North America. Part III, Viviparidæ and Rissoidæ. Smithsonian Misc. Coll., No. 144, 1865.

The two preceding titles cover all the univalve shells of Indiana except the *Strepomatidæ*, and most of the forms are well illustrated.

Binney, W. G. Terrestrial Air-Breathing Mollusks of the United States and the Adjacent Territories of North America. Bulletin Mus. Comp. Zool., Vol. IV, text and plates in two volumes, 1878.

This important work brings down to its date all information connected with land shells of North America. It is now rare.

Binney, W. G. A Manual of American Land Shells. Bulletin United States National Museum, No. XXVIII, 1885.

This valuable volume brings down to its date all information connected with land mollusca which the indefatigable labors of Dr. Binney had brought to light. It contains illustrations of all the accepted forms, and is especially valuable to students of Indiana mollusca.

Call, R. Ellsworth. Note on the Genus *Campeloma* of Rafinesque. American Naturalist, June, 1883, pp. 603-608, 1883.

This paper gives the history of the generic names applied to this interesting group.

Call, R. Ellsworth. A Geographic Catalogue of the Unionidæ of the Mississippi Valley. Bulletin Des Moines Academy of Science, Vol. I, No. 1, pp. 5-57, 1885.

Contains full notes on geographic distribution of all forms found in Indiana, with bibliographic reference to the original figures.

Call, R. Ellsworth. On the Genus *Campeloma*, Rafinesque, with a Revision of the Species, Recent and Fossil. Bulletin of the Washburn College Laboratory of Natural History, Vol. I, No. 5, pp. 149-165, plates ii-vi, 1886.

Contains descriptions of all the forms found in Indiana, with illustrations. Gives full notes on geographic distribution.

Call, R. Ellsworth. On the Gross Anatomy of *Campeloma*. American Naturalist, June, 1887, pp. 491-497, 1887.

Gives description of the soft parts and notes sexual differences. Gives characters by which sexes may be distinguished.

Call, R. Ellsworth. A Contribution to a Knowledge of Indiana Mollusca. Proceedings Indiana Academy of Science, Vol. III, pp. 140-160, 1893 (1894).

Lists all the forms certainly known from the State, and gives a short bibliography of the most important papers.

Call, R. Ellsworth. On the Geographic and Hypsometric Distribution of North American Viviparidæ. American Journal of Science, Third Series, Vol. XLVIII, pp. 132-141, with map, 1894.

Contains full data relating to the distribution of all the members of this group.

Call, R. Ellsworth. The Unionidæ of the Ohio River. Proceedings of the Indiana Academy of Science, Vol. IV, pp. 139-140, 1894.

This is a brief paper, in abstract, correlating certain facts of geographic distribution with geologic data.

Call, R. Ellsworth. The Strepomatidæ of the Falls of the Ohio. Proceedings of the Indiana Academy of Science, Vol. IV, pp. 140-143, 1894.

This short paper has notes on the abundance and biologic surroundings of the shells of this great group found on the falls of the Ohio. It has nothing of value to the systematist.

Call, R. Ellsworth. A Revision and Synonymy of the Parvus Group of Unionidæ. With six plates. Proceedings of the Indiana Academy of Science, for 1895, pp. 109-119, 1896.

All the forms of this very difficult group are passed in review in this paper, and all accepted ones are figured, together with most of the synonyms. The two forms of the group from Indiana stand as types of sub-groups.

Call, R. Ellsworth. Second Contribution to a Knowledge of Indiana Mollusca. Proceedings Indiana Academy of Science, for 1895, pp. 135-146, 1896.

This paper contains full notes on synonymy of many species, together with their geographic distribution within the State. All forms known to be in the State collections at Indianapolis are specially indicated.

Call, R. Ellsworth. On a Small Collection of Mollusks from Northern Indiana. Proceedings Indiana Academy of Science for 1895, pp. 246-250, 1896.

This is a report on the mollusca collected at the station of the Indiana University Biological Laboratory, by members of the University. It deals chiefly with the mollusks of Turkey Lake.

Call, R. Ellsworth. Illustrations of Little Known Unionidæ. Journal Cincinnati Society of Natural History, Vol. XVIII, pp. 157-160, pl. vi, 1896.

Description, emended, with figures, of *Unio æsopus* Green. The synonymy of the species is also indicated and the belief stated that Green's shell is the *Obliquaria cyphia* Rafinesque.

Call, R. Ellsworth. Fishes and Shells of the Falls of the Ohio. Memorial History of Louisville, Vol. I, Chapter II, pp. 9-20, quarto, 1896.

This is the first paper to treat of this single limited area and lists all the mollusca known from the Falls.

Call, R. Ellsworth. A Study of the Unionidæ of Arkansas, with Incidental Reference to their Distribution in the Mississippi Valley. Transactions of the Academy of Sciences of St. Louis, Vol. VII, No. 1, pp. 1-64, plates i-xxi, 1895.

This paper gives much synonymy and lists many forms common in Indiana. It describes fully, with figures, all of the species usually ascribed to Lamarck and gives the full history of all such forms.

Call, R. Ellsworth. The Hydrographic Basins of Indiana and their Molluscan Fauna. Proceedings Indiana Academy of Science, for 1896, pp. 247-258, with hydrographic map, 1897.

Contains succinct geographic distribution of all the fresh-water forms found in the State.

Chenu, J. C. Bibliotheque Conchyliologique, Tome III, 1845.

This rare volume contains reprints, with all the plates, of Rafinesque, Say, and Conrad's several important works on American mollusca. Though in French, the matter appears unchanged.

Conrad, T. A. New Fresh-Water Shells of the United States, with Colored Illustrations, and a Monograph of the Genus Anculotus of Say; also A Synopsis of the American Naiades, 1834.

This book was the cause of a long and unfortunate personal controversy with Dr. Isaac Lea.

Conrad, T. A. Monography of the Family Unionidæ, or Naiades of Lamarck, of North America, 1835-1839.

After publishing 117 pages of text and 66 plates the work was discontinued and left incomplete. It is now rare, but necessary for extended study of Uniones.

Conrad, T. A. Synopsis of the Family of Naiades of North America, with Notes, and a Table of Some of the Genera and Subgenera of the Family, According to their Geographic Distribution, and Descriptions of Genera and Subgenera. Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. VI, pp. 244-269. Also issued in the form of a pamphlet, 1853.

Conrad, T. A. Descriptions of New Species of Unio. Journal of the Academy of Natural Sciences, Philadelphia, Vol. II, Part 4, pp. 295-298, 1854.

This paper describes *Unio arquatus* and *Unio pectitus*, both from the Wabash River.

Cooper, William. List of Shells Collected by Mr. Schoolcraft in the Western and Northwestern Territory. Narrative of an Expedition through the Upper Missouri to Itasca Lake, etc., pp. 153-156, appendix, 1834.

This is little more than a list with some valuable suggestions bearing on synonymy.

Drew, Gilman. The Anatomy of *Sphaerium sulcatum* Lamarck. Proceedings Iowa Academy of Science, Vol. III, pp. 173-182, plates i-iii, 1896.

This is a most valuable and suggestive paper and is one of the first of its kind to be published in this country.

Eaton, H. H. *Vide* Short, C. W., and Eaton, H. H.

Ferussac, Baron de. Observations adressees en Forme de Lettre a MM. Th. Say, C. S. Rafinesque, Is. Lea, S. P. Hildreth, T. A. Conrad et C. A. Poulson sur la Synonymie des Coquilles bivalves de l'Amerique Septentrionale, et Essai d'une Table de Concordance a ce Sujet. Magasin de Zoologie, Classe V, Nos. 59, 60, pp. 1-36, 1835.

Green, Jacob. Some Remarks on the Unios of the United States, with a Description of a New Species. Contributions of the Maclurian Lyceum to the Arts and Sciences, Vol. I, No. 2, p. 41, 1827.

This title contains a description of a form of shell (*Unio æsopus*) found in both the Ohio and Wabash Rivers, with a good figure, the type coming from Pittsburg.

Green, Jacob. Notes on the American Shells Figured in the Supplement to the Index Testaceologicus. Transactions of the Albany Institute, Vol. I, pp. 134-136, 1830.

Contains notes on synonymy of several of Barnes's Unios and other matters.

Haldemann, S. S. A Monograph of the Limniades and Other Fresh-Water Univalve Shells of North America, 1840-1846.

Haldemann, S. S. Observations on the Melanians of Lamarck. American Journal of Science and Arts, First Series, Vol. XLI, No. 1, pp. 21-23, 1841.

Haldemann, S. S. Correction (to article on Melanians, American Journal of Science, Vol. XLI, p. 21). American Journal of Science and Arts, First Series, Vol. XLII, p. 216, 1841.

Haldemann, S. S. The Iconographic Encyclopedia of Science, Literature and Art, Systematically Arranged. Translated from the German, Vol. II, pp. 69-90, 1857.

Haldemann, S. S. Illustrations Conchyliologiques, Par M. Chenu. No date. One (Liv. 73) of a series of many reprints in French.

Hildreth, S. P. Observations on and Descriptions of the Shells found in the Waters of the Muskingum River, Little Muskingum and Duck Creek, in the Vicinity of Marietta, Ohio. American Journal of Science and Arts, First Series, Vol. XIV, pp. 276-291, 1828.

This paper rudely figures many of the common forms of the Ohio Valley and contains the original description of the remarkable *Unio foliatus* Hildreth.

Hildreth, S. P. Disease among Shell Fish. American Journal of Science and Arts, First Series, Vol. XXXII, pp. 97-98, 1837.

Relates a curious epidemic among Uniones in the Muskingum River; the note is hidden away securely in the midst of some meteorological notes made at Marietta, Ohio.

Kirtland, J. P. Observations on the Sexual Characters of the Animals Belonging to Lamarck's Family of Naiades. American Journal of Science and Arts, First Series, Vol. XXVI, No. 1, pp. 117-120, 1834.

This interesting article is accompanied by rude outline figures of sexual shapes of shells which are the first to be published in this country.

Kirtland, J. P. Second Annual Report of the Geological Survey of Ohio, pp. 170-175 and 197-200, 1838.

This volume contains a list of Ohio mollusca and at its end several pages of notes which have valuable suggestions on synonymy.

Kirtland, J. P. Fragments of Natural History. No. 1, Habits of the Naiades. American Journal of Science and Arts, First Series, Vol. XXXIX, No. 1, pp. 164-168, 1840.

Kirtland, J. P. Remarks on the Sexes and Habits of Some of the Acephalous Bivalve Mollusca. Proceedings of the American Association for the Advancement of Science, Vol. V, pp. 85-91, 1851.

Lea, Isaac. Observations on the Genus *Unio*, 1830-1874.

These volumes, thirteen in number, were originally published as portions of the Transactions of the American Philosophical Society and of the Journal of the Academy of Natural Sciences of Philadelphia. They were afterwards collated and issued under the above title. They are absolutely indispensable to all students of American fresh-water mollusca.

Lea, Isaac. A Synopsis of the Family of Naiades, 1830-1870.

This work has passed through four editions. The first appeared as a portion of Vol. I of the quarto series of Observations. The second was published in octavo form in 1836. The third edition appeared in 1852, while the fourth and last was published in 1870.

The latest edition contains many useful hints on synonymy which it is to be regretted Dr. Lea did not himself fully follow to conclusion.

Lea, Isaac. Rectification of Mr. T. A. Conrad's Synopsis of the Family of Naiades. Proceedings of the Philadelphia Academy of Natural Science, Vol. VII, pp. 236 et seq., 1854.

Lewis, James, M. D. On *Unio subrostratus* Say. Proceedings Philadelphia Academy of Natural Science, for 1878; reprint, pp. 4.

This brochure contains some valuable notes on the synonymy of a shell which was originally described from Indiana.

Levette, G. M. Observations on the Depth and Temperature of Some of the Lakes of Northern Indiana. Annual Report Indiana Geological Survey for 1875, pp. 496-499, 1876.

This paper contains a list of the mollusca of northern Indiana prepared by J. W. Byrkit, of Indianapolis. Thirty-eight forms are mentioned.

Moore, D. R., and Butler, A. W. Land and Fresh-Water Mollusca Observed in Franklin County, Indiana. Bulletin Brookville Society of Natural History, No. 1, pp. 41-44, 1885.

This valuable paper gives the best extant account of the mollusca of southeastern Indiana. Sixty-three species in all departments are listed.

M'Murtrie, H. Sketches of Louisville and its Environs, etc., First Edition, 1819.

This very rare work contains on pages 65-66 a list of mollusca from the vicinity of Louisville, many of which are from the Falls of the Ohio. The author, M'Murtrie, states that for the list he is indebted to "the politeness of that accomplished and skillful naturalist, Mr. Rafinesque."

Menke, C. T. Synopsis methodica Molluscorum, etc., quae in Museo-Menkeano adservantur; cum synonymia critica et novarum specierum diagnosibus. Pyramonti, 1830.

This very scarce book contains a number of descriptions of Melanians from the Ohio River at Cincinnati.

Nicklin, P. H. Conchological Observations on Lamarck's Family of Naiades. Transactions American Philosophical Society, New Series, Vol. III, pp. 395-399, 1829.

Nicklin, P. H. Des Moulins' General Considerations on Restricting the Number of Species of the Genera *Unio* and *Anodonta*. From the French. American Journal of Science and Arts, First Series, Vol. XLI, No. 1, pp. 104-116, 1841.

Pleas, E. Shells of Henry County. The Nautilus, Vol. VII, No. 6, pp. 68-70, 1893.

This excellent paper lists 59 species and varieties of land mollusks and 64 species and varieties of fresh-water forms, all found within a radius of five miles of Dunreith.

Plummer, Dr. John T. Scraps in Natural History (Mollusca). American Journal of Science and Arts, First Series, Vol. XLVIII, No. 1, pp. 93-96, 1844.

This paper gives a list of the shells found about Richmond, Wayne County. The list contains the names of 21 species of land shells, eight univalve fresh-water forms, one *Anodon*, two *Margaritanas* and one *Sphaerium*.

Poulson, C. A. A Monograph of the Fluvial Bivalve Shells of the River Ohio, Containing Twelve Genera and Sixty-Eight Species, 1832.

This work is a translation of Rafinesque's work, which is mentioned below. The frontispiece, under the name of *Unio verrucosa* Rafinesque, has a fine plate of the purple naced variety of *Unio tuberculatus* Barnes.

Prime, Temple. Descriptions of Cycladidae. Proceedings Boston Society of Natural History, Vol. IV, pp. 155-165, 1852.

Prime, Temple. Notes on the Species of *Cyclas* Found in the United States; with Descriptions and Woodcuts. Proceedings of the Boston Society of Natural History, Vol. IV, pp. 271-285, 1853.

Prime, Temple. A Monograph of American Corbiculadae, Recent and Fossil. Smithsonian Miscellaneous Collections, No. 145, 1865.

This work is indispensable to all students of American mollusca.

Rafinesque, C. S. Discoveries in Natural History in the Western States. American Monthly Magazine and Critical Review, Vol. III, p. 354, 1818.

Rafinesque, C. S. Further Account of Discoveries in Natural History in the Western States. American Monthly Magazine and Critical Review, Vol. IV, p. 38, 1818.

Rafinesque, C. S. General Account of the Discoveries Made in the Zoology of the Western States. *American Monthly Review and Critical Magazine*, Vol. IV, p. 106, 1818.

Rafinesque, C. S. Prodrôme de 70 nouveaux Genres d'Animaux découverts dans l'Intérieur des Etats-Unis d'Amérique, durant l'Année 1818. *Journal de Physique, de Chimie, d'Histoire Naturelle et des Arts*, Tome LXXXVIII, p. 417, 1819.

Rafinesque, C. S. Description of a New Genus of Fluvial Bivalve Shell of the Brachiopoda, *Notrema Fissurella*, etc. *American Monthly Magazine and Critical Review*, Vol. IV, p. 356, 1819.

Rafinesque, C. S. *Apolosia*, the Mollusca. *The Annals of Nature*, No. 1, pp. 10, 11, 1820.

This short article appeared in one of the numerous journals which Rafinesque started in Philadelphia.

Rafinesque, C. S. Monographie des Coquilles bivalves et fluviatiles de la Rivière Ohio, contenant douze Genres et soixante-huit Espèces: par M. C. S. Rafinesque, Prof. de Bot. et d'Hist. nat. à l'Uni. Transylvane de Lexington. Extrait de la 15^{me} Livraison du 5^{me} Tome des *Annales Générales des Sciences Physiques*, September, 1820, Bruxelles.

Rafinesque, C. S. Enumeration and Account of Some Remarkable Natural Objects in the Cabinet of Professor Rafinesque, in Philadelphia, 1831.

This paper proposes several new genera of land shells, some of which are yet recognized, very properly.

Rafinesque, C. S. *Odatelia*: New Genus of North American Fluvial Bivalve Shells. *Atlantic Journal and Friend of Knowledge*, No. 4, p. 154, 1832.

Rafinesque, C. S. Complete Writings of, on Recent and Fossil Conchology. Edited by Wm. G. Binney and George W. Tryon, Jr., New York, 1864.

This work, which gives all of the published papers of Rafinesque, is indispensable to any student who seeks to clear up the historical sequence of species and their descriptions.

Say, Thomas. Conchology. *Nicholson's Encyclopedia*, Vol. II, four plates, no pagination. First edition, 1816.

A second edition of this work was published in 1818, also unpagged; a third edition in 1819, Vol. IV, which contains a number of

forms not included in the two earlier editions. A separate edition of the article was issued under the title "Descriptions of the Land and Fresh-Water Shells of the United States," from the first edition. A copy is now in my possession.

Say, Thomas. American Conchology; or, Descriptions of the Shells of North America, 1830-1834.

This was Say's chief work on American mollusca and was prepared and printed at New Harmony. The work was published in parts, seven in all appearing, the last part being a posthumous work under the editorship of T. A. Conrad.

Say, Thomas. Descriptions of Some New Terrestrial and Fluvial Shells of North America. New Harmony Disseminator of Useful Knowledge, Vol. II, July, 1829, to January, 1831.

Say, Thomas. Descriptions of Several New Species of Shells and of a new Species of Lumbricus. Transylvania Journal of Medicine, Vol. IV, pp. 525-528, 1831.

Say, Thomas. A Glossary to Say's Conchology, 1832.

This is a good specimen of the printing of that date in Indiana, the work being all done at New Harmony.

Say, Thomas. Descriptions of Some New Terrestrial and Fluvial Shells of North America, 1829, 1830, 1831, New Harmony, Indiana, 1840.

This title reprints the earlier articles under the editorship of Mrs. Say.

Say, Thomas. Complete Writings on American Conchology. See under Binney, W. G. 1858.

Shaeffer, D. F. A Complete List of the Land and Fresh-Water Shells Found in the Immediate Vicinity of Cincinnati, Ohio.

This brochure is without date. There are no descriptions, but some synonymy is suggested.

Short, C. W., and Eaton, H. H. Notices of Western Botany and Conchology. Transylvania Journal of Medicine, February, pp. 74-82, 1831.

Shumard, B. F. Catalogue of the Naiades of Jefferson County, Kentucky. The Naturalist and Journal of Agriculture, Horticulture, Education and Literature, Franklin College, Tennessee, Vol. I, No. 3, pp. 105, 106, 1846.

This paper contains a list of species, with supposed synonyms; the writer shows evident confusion as to specific facts and values. The article contains most of the names of shells found in the Ohio at Louisville.

Simpson, C. T. On the Mississippi Valley Unionidæ Found in the St. Lawrence and Atlantic Drainage Areas. *American Naturalist*, Vol. XXX, pp. 379-384, 1896.

Stein, Fred. The Molluscous Fauna of Indiana. Annual Report of the Indiana Geological Survey for the year 1880, pp. 451-467, 1881.

This is the first published list to try and include all the shells of the State.

Stimpson, William. Researches upon the Hydrobiinae and Allied Forms. *Smithsonian Miscellaneous Collections*, No. 201, 1865.

Tryon, George W., Jr. A Monograph of the Terrestrial Mollusca Inhabiting the United States, New York, 1866.

Tryon, George W., Jr. Land and Fresh-Water Shells of the United States, Part IV, Strepomatidae. *Smithsonian Miscellaneous Collections*, No. 253, 1873.

SYSTEMATIC CATALOGUE.

PULMONATA GEOPHILA.*

ARTIFICIAL KEY TO THE LAND MOLLUSCA.

- | | |
|--|------------------------------|
| A. Animal without external shell. | <i>Limax, Tebennophorus.</i> |
| B. Animal with external shell. | |
| a. Shell large, lip reflected, one parietal tooth. | <i>Mesodon.</i> |
| b. Shell large, lip reflected, one parietal and two peritremal teeth. | <i>Triodopsis.</i> |
| c. Shell small, lip reflected, aperture contracted, with a parietal tooth. | <i>Stenotrema.</i> |
| d. Shell with simple lip, umbilicated, epidermis striate, usually colored with bands or spots. | <i>Patula.</i> |
| e. Shell with simple lip, polished epidermis, with or without umbilicus. | <i>Zonites; Macrocyctis.</i> |
| f. Shell small, conical, coarsely striate, lip reflected. | <i>Strobila.</i> |
| g. Shell very small, discoidal, lip reflected, ribbed or smooth. | <i>Vallonia.</i> |
| h. Shell minute, elongated, lip reflected, pupiform. | <i>Pupa.</i> |
| i. Shell minute, lip not reflected, conical, brown. | <i>Vertigo.</i> |
| j. Shell long, whorls loosely coiled, aperture very large and effuse, peritreme acute. | <i>Succinea.</i> |

*The systematic arrangement here adopted for the land shells of Indiana follows that of Dr. Binney in "A Manual of American Land Shells," pp. 57-59, which constitutes Bulletin No. 28, United States National Museum. Not only has his arrangement been closely followed, but his descriptions of the several forms have been employed, modified occasionally in view of the large series which the writer has personally collected and studied. All notes concerning habits, distribution, and other characters, are original and the writer should be held responsible therefor.

FAMILY SELENITIDÆ.

MACROCYCLIS CONCAVA Say. Plate 4, figs. 4, 7.

Shell depressed, very slightly convex on the upper surface; epidermis whitish horn color, sometimes with a tinge of green; whorls



Fig. 1.

five, above flattened, below rounded, finely striate obliquely, and sometimes with microscopic revolving lines, the outer whorl spreading a little towards the aperture; suture rather deeply impressed; umbilicus

wide, deep, exhibiting all the volutions to the apex; aperture rounded, somewhat flattened above, its edge frequently tinged with reddish brown; peristome subreflected at its columellar extremity, simple above, and in some specimens considerably depressed near its junction with the outer whorl; columella with a thin callus, the edge of which connects the upper and lower extremities of the peristome. (Binney.)

Large specimens occasionally reach the following dimensions: Greater diameter 24, lesser 18 mm.; height, 7-8 mm. A considerable difference in height exists among specimens from different localities, since this character appears to depend on rate of growth and the nature of the habitat. Among rocks the forms are more flat than those which are taken in the open woods under logs and debris.

This species is a voracious feeder and destroys others of its kind as well as other helices. It may be sought for on open hillsides, where there is constant moisture, and under leaves, logs and sticks. I have sometimes taken them in the apertures of the larger helices, into which they had entered, probably to find food. This species is common all over the southern portions of Indiana, and has been found as far north as Wabash and Huntington. It probably occurs all over the State.

FAMILY LIMACIDÆ.

LIMAX CAMPESTRIS Binney. Plate 4, fig. 18.

Color usually of various shades of amber, without spots or markings, sometimes blackish; head and eye-peduncles smoky; body cylindrical, elongated, terminating in a very short carina at its posterior extremity; mantle oval, fleshy, but little prominent, with fine, concentric lines;

back covered with prominent elongated tubercles and furrows; foot narrow, whitish; respiratory foramen on the posterior dextral margin of the mantle; body covered with a thin, watery mucus. (Binney.)

This species is easily recognized among all that dwell in this State. It is the lightest colored of all the small forms, in some individuals being darker only towards the anterior portion of the body. Its length varies from 20 to 25 mm. when stretched to full length in crawling about. It is to be sought for under boards, flat stones, bark, fallen trees, in the woods and about dwellings, and is one of the most common of the slugs. It may be readily traced to its hiding places by the abundant trail of shining white mucus which it leaves behind it in progressing.

LIMAX FLAVUS Linnæus. Plate 7, fig. 5.

Color brownish, yellowish brown or ashy brown, with oblong-oval, uncolored spots, which have a longitudinal disposition; mantle with rounded spots; head, neck and eye-peduncles blue, semi-transparent; tentacles white; base of foot sallow white. Body when extended cylindrical, elongated, terminating acutely with a short but prominent keel; upper part covered with long and narrow, prominent tubercles. Mantle ample, oval, rounded at both ends, with numerous very fine, concentric striae. Sides paler and without spots. Respiratory foramen large, placed near the posterior lateral margin of the mantle and cleft to the edge. Generative orifice indicated by a white spot a little behind the eye-peduncle of the right side.

This is the largest slug which is found in this State, but is not indigenous. It is introduced from Europe, and has been seen by me only at Lawrenceburg, in the southeastern part of the State. It is common in cellars and about well curbs in Louisville, Kentucky, and should be found in New Albany and Jeffersonville, Indiana. The Lawrenceburg examples probably found their way here through the large German population, which introduced them by accident. Careful search about well curbs, in damp cellars, and under refuse piles, such as old bricks, may bring many specimens to light. The writer collected over two thousand specimens in 1884 in the heart of the city of Washington, not far from the Smithsonian Institution, in whose collections more than a thousand were placed. They were found in the greatest abundance under old brick piles on the site of an old dwelling; associated with them were thousands of specimens of *Triodopsis tridentata*, of which two cigar boxes full were collected! The slug may prove to be abundant in southern Indiana. Binney mentions the attainment of a length, in captivity, of 200 mm., thus rivaling all

American forms except the great *Ariolimax columbianus* of the west coast.

ZONITES FULIGINOSUS Griffith. Plate 4, fig. 13.

Shell thin, depressed on the upper surface, epidermis dark, approaching to chestnut color, sometimes almost black, shining and wrinkled; whorls four and one-half, rapidly increasing, with irregular, oblique wrinkles, the last whorl very voluminous and expanding transversely toward the aperture; suture very little impressed; aperture very oblique, ample, lunate-ovate, within pearly or iridescent; peristome simple, thin, brittle, with a light, testaceous deposit within, the two terminations approaching each other very nearly, that of the columella somewhat reflected; umbilicus deep, not much expanded. (Binney.)

This species is one of the more uncommon forms which occur on favorable hillsides, under leaves, and half buried in the moist soil. It is usually a dark mahogany brown, smooth, highly polished shell. I have taken it at Corydon, Madison, and near Bloomington; it is rare at Lawrenceburg and at Brookville. But on the south side of the Ohio, in Kentucky opposite Lawrenceburg, Indiana, it is both common and large. It can not well be mistaken for any other species. It is usually solitary, being unlike others of its congeners in this respect. The lines of growth are sometimes very black and are sometimes wrinkled, but usually the shell is quite smooth. I do not know of any localities in the northern portion of the State where this form has been found.

ZONITES FRIABILIS W. G. Binney. Plate 4, fig. 10.

Shell very globose, transparent, brittle, thin, sometimes thick, shining, reddish; spire very short, conic; whorls five, convex, lightly wrinkled, rapidly increasing, the last very large and ventricose; suture moderate; aperture circular, equally high and broad, within bluish and slightly thickened by a very thin white callus; peristome simple, sharp, thin, at its junction with the body whorl violet-colored and reflected, so as to cover a portion of the small and deep umbilicus; the parietal wall of the aperture is covered with a light violet-colored callus. (Binney.)

I have never found this species in Indiana, and enter it on the authority of Mr. Binney, who has it from some Indiana localities. It is, however, a common shell in parts of Kentucky, where I have collected it. The species may be very easily separated from the preceding form by its greater height and by its color being always far more light

than any variety of *Zonites fuliginosus* which I have seen. The more globose character of the shell will alone distinguish it; add to this the size and shape of the aperture and of the body whorl, and no mistake need be made. Mr. Binney gives the same measurements for the two forms, but I have never seen one as flat as *Z. fuliginosus*, but it does not attain the diameter of that species.

ZONITES LIGERUS Say. Plate 4, fig. 11.

Shell perforated, orbicularly convex; epidermis yellowish horn color, shining; whorls seven, finely and thickly striated transversely, smooth below; suture not much impressed; aperture semi-lunate, rounded; peristome thin, acute; base and side of the outer whorl, within the aperture, thickened and white; perforation very small; umbilical region impressed. (Binney.)

This form is very common all over the southern portions of the State, having been taken by me in most of the river counties and as far north as Indianapolis and Bloomington. It is abundant under flat rocks on hillsides with southern exposure about Madison and Corydon, rare about Lawrenceburg, abundant about Brookville. It is closely related to the following form, from which it is with difficulty distinguished and which may perhaps be justly regarded as a synonym. The older specimens are said by W. G. Binney to be flatter at the base and to have a thicker and whiter callus within the aperture, but these differences are hardly specific; both facts may be explained on the basis of habitat and food opportunities. The animals are so much alike that they can not be used for separation. I have often received the immature forms of *Mesodon elevatus* under this name, as well as under that of the following species, but the character of the whorls and the generally immature character of the aperture of *M. elevatus* will serve any careful student to separate them.

ZONITES INTERTEXTUS Binney. Plate 4, fig. 12.

Shell perforated, subpyramidal; epidermis yellowish horn color; whorls six or seven, with numerous fine, oblique striae and very minute, spiral striae, intersecting each other; outer whorl with a narrow, light-colored band and an ill-defined, brownish band below it; aperture rounded, a little transverse; peristome thin, somewhat thickened within by a deposition of testaceous matter, its columellar extremity slightly reflected at its junction with the base of the shell; perforation small, sometimes nearly obsolete; base whiter than the upper surface. (Binney.)

This shell is very close to the preceding and may not, perhaps, be justly separated from it. The light-colored band is by no means the rule, while the darker colored band is seen in but few of the specimens. I have taken a number in the vicinity of Cincinnati, Ohio, with this band well marked, but have seen no Indiana specimens with it. The distribution is about the same as for the above; in short, locality which affords one species will generally afford the other. Mr. Binney states that the genitalia differ in a marked manner from those of the preceding species, a fact the value of which depends altogether on the time when they are collected. It has been noticed that when the reproductive functions are active the characters of the genitalia differ very much indeed in the same species if examined during the close season. I am not disposed to attach much importance to these characters as affording specific differences. The two species attain to the same relative dimensions, the greater diameter being about 15, the lesser 13 mm.; the height is about 10 mm.

ZONITES INORNATUS Say. Plate 4, figs. 14, 15.

Shell depressed; epidermis yellowish horn color, smooth, shining, with very minute lines, not breaking the smoothness of the surface; whorls five; suture not much impressed; aperture transverse, scarcely oblique, obliquely lunar, with a thick, white testaceous deposit around its whole inner surface, a little distant from the margin; peristome thin, acute, fragile, its ends somewhat converging, the columellar margin reaching to the center of the base, subdilated above; umbilicus small; base rather flattened, indented in the center. (Binney.)

This is a widely distributed species over the eastern United States, but does not seem to be abundant in the central west. In Indiana I have taken specimens at Corydon, at Madison, and at Lawrenceburg. I do not know how far it may range to the northwards. This species will afford a good illustration of the kind and amount of work yet to be done on Indiana mollusca. There is no other species in this State with which this form may be confused, unless it be the half-grown of *Zonites fuliginosus*. But it is easily distinguished by all the signs of maturity and by the very small umbilicus, that of juvenile *Z. fuliginosus* being quite large. The animal is a dark slate color, slender, and is very active in its movements. The size of three-fourths of an inch in diameter is rarely attained, the shell being usually somewhat less than that.

ZONITES (HYALINIA) ARBOREUS Say. Plate 4, fig. 1.

Shell umbilicated, depressed, very slightly convex, thin, pellucid; epidermis amber-colored, smooth, shining; whorls four to five, with

very minute, oblique striae, apparent when viewed with the microscope; aperture transversely rounded; peristome thin, acute; umbilical region indented; umbilicus moderate, well developed, round and deep. (Binney.)

This is one of the smallest members of this genus, its diameter being about five mm., or one-eighth of an inch. In noting the color of the epidermis it will be necessary to examine the shell after the animal is removed, since the animal is very dark, almost or quite black, which makes the shell seem darker than it really is. The species is found all over Indiana, under boards about dwellings, under sticks, flat stones, under bark and logs, but especially hidden away between the bark and wood of old fallen trees. It is usually somewhat gregarious; when one specimen is found many others are sure to be in the immediate neighborhood, hidden away in cracks or crevices. From the next species, which it resembles in size, it is readily separated by its color, more depressed spire and shape of the aperture, while it has a much smaller umbilicus.

ZONITES (HYALINIA) LIMATULUS. Ward. Plate 4, fig. 16.

Shell widely umbilicated, small, depressed, thin; epidermis whitish, immaculate; suture distinctly impressed; whorls more than four, convex, with very fine, oblique, parallel striae, which become obsolete on the base; aperture oblique, subcircular, slightly modified by the penultimate whorl; peristome thin, acute, its ends approaching; umbilicus rounded, large and deep, not exhibiting all the volutions. (Binney.)

This species has been found near Wabash, Terre Haute, and Indianapolis, and is likely to occur throughout the State. It could only be confused with the preceding form.

ZONITES (CONULUS) FULVUS Draparnaud. Plate 4, fig. 2.

Shell imperforate, subconical, thin, pellucid; epidermis smooth, shining, minutely striated, amber-colored; whorls five or six, rounded, very narrow; suture distinct and deep; aperture transverse, narrow; peristome simple, acute; base convex; umbilical region indented, umbilicus closed.



Fig 2.

This is a very small shell, having a diameter of only some four mm. and a height of three mm. Binney's description, above quoted, gives all the characters which the species presents except the color of the animal, which is very dark, almost black. The shell is so thin that

the color of the animal striking through it makes the living form appear almost black; only on examination of shells cleared of the animal can the real amber color be noted.

This species occurs all over the State in favorable localities, and is one of the circumpolar species. Under logs which lie in damp places, in the cracks of bark, between the bark and wood of fallen trees, are all stations in which it delights to dwell. It can be confused with no other form.

ZONITES (GASTRODONTA) INTERNUS Say. Plate 4, fig. 17.

Shell very narrowly perforated, depressed, slightly convex; epidermis reddish brown, shining; whorls eight, with regular, equidistant, elevated, oblique, rounded ribs, separated by distinct grooves; suture deeply impressed; aperture flattened, transverse, narrow; peristome thin, acute, thickened internally; within the base of the aperture, somewhat distant from the margin, are two prominent, sublamelli-form, white teeth, not reaching the edge of the peristome; base smooth, polished, umbilical region indented. (Binney.)

This shell occurs in numbers on the hillsides of southeastern Indiana, but is most abundant in the vicinity of Cincinnati, Ohio. Hundreds of examples were collected by the writer, in Eden Park, after a warm rain, many of the animals of which were pinkish in color, a fact which Mr. Binney has noted. In this State no other forms occur with which it may be confounded except by careless collectors who sometimes mistake very young *Mesodon clausus*, or related forms, for it. Its identity may be readily established by breaking open the peristomal margin, when the several consecutive thickenings, resembling tooth-like processes, may be seen on the outer wall. The species has also been taken at Madison, under flat stones on the hillsides high above the town.

FAMILY PHILOMYCIDÆ.

TEBENNOPHORUS CAROLINENSIS Bosc.

Color of upper surface whitish or yellowish white, variegated with clouds and spots of brownish and blackish, so arranged as to form three ill-defined longitudinal bands, one on the center of the back and one on each flank, extending from the head to the posterior extremity, anastomosing more or less with each other, and having smaller spots of the same color between them; inferior margin white or yellowish;

foot whitish. Mouth surrounded with a circular row of papillae. Body elongated, subcylindrical, flattened towards its posterior extremity, which is obtuse; eye-peduncles one-fourth of an inch long, brownish or blackish, stout, terminating in a bulb; ocular points on the superior part of the bulb; tentacles immediately below the eye-peduncles, white, very short, nearly conical. Mantle fleshy, covering the whole body, its anterior edge tinged with brownish, and falling in a slight curve between the two eye-peduncles, reaching on the sides to the margin of the foot; posterior extremity rounded; cuticle covered with irregular vermiform glands, anastomosing with each other, and having a general tendency to a longitudinal direction, with shallow furrows between, lubricated with a watery mucus, and susceptible of contractions which produce a slow, undulatory motion, like the flowing of water, over the whole surface. Foot whitish, extending a little beyond the mantle posteriorly, showing a whitish, flattened border. Orifice of the organs of generation on the right side, at a little distance behind and below the eye-peduncles. Respiratory orifice large, on the right side, one-fourth of an inch behind the origin of the eye-peduncle; anal orifice in close contact, a little above and in front of it; above the respiratory orifice, on the back, is a deep, curved furrow, running upwards and backwards. Locomotive band not distinguished from the lower surface of the foot. (Binney.)

This species of slug is very common all over middle and southern Indiana, in suitable situations. I have found it abundantly in southeastern Indiana, under bark, in wet places, clinging to the wood where the bark had been slightly raised. It is protectively colored and the pattern described by Binney is by no means the most common one. It is impossible to assign any particular color pattern to the species, for it is very variable. But ashy gray colors appear to predominate. The animal, when stretched out to full length, is often more than 100 mm. in length, and is the largest slug native to the eastern United States. When collected living and thrown into alcohol, the animal soon becomes covered with a very dense coating of thickened and hardened mucus, which obscures all color markings. It may be easily traced to its hiding place under bark by the very broad line of shining mucus which it leaves in its track. The species can be confounded with no other occurring in the State. I have often taken this form on the sides of trees, after rains, climbing slowly along the creases of the bark. On one occasion several specimens were taken from the same tree, on a wooded hillside on the Ohio River, opposite Lawrenceburg. In this situation the protective value of its coloration may be fully appreciated.

TEBENNOPHORUS DORSALIS Binney, Plate 4, fig. 19.

Color of upper surface ashy, with a shade of blue, an interrupted black line extending down the center of the back; eye-peduncles black, about one-eighth of the length of the body; tentacles blackish, very short. Body cylindrical and narrow, terminating posteriorly in an acute point; base of foot white, very narrow, its separation from the body not well defined. Upper surface covered with elongated and slightly prominent glandular projections, the furrows being indistinct. Respiratory orifice very minute, situated on the right side, about one-eighth of an inch behind the insertion of the eye-peduncle. The mantle is closely connected with the body. (Binney.)

This species, as above described by Binney, is doubtless the most common slug in Indiana, a dozen or more being often found under the same log or plank. It is found in the woods, and on the margins of forests, in driftwood lodged on the banks of rivers, under flat rocks, and, in short, in every location which offers protection. Its small size, pointed posterior when fully extended, dark coloration, and white creeping disk serve to separate it from all other slugs likely to fall in the way of Indiana collectors.

FAMILY HELICIDÆ.

PATULA SOLITARIA Say. Plate 4, fig. 20, and Plate 5, fig. 1.

Shell broadly umbilicated, globosely depressed, coarse, solid, diaphanous, obliquely and crowdedly wrinkled, from white to dark reddish horn color, with from two to three brownish revolving bands; whorls six, convex; suture deep; aperture roundedly lunate, pearly white and banded within; peristome simple, acute, its ends joined by a thin, transparent callus, that of the columella dilated, subreflected. (Binney.)

This species occurs all over the southern two-thirds of the State, and usually in very great numbers. But the extreme abundance of this form in the Ohio drainage basin, as shown by extensive collections, places its metropolis along the Ohio River. It is one of the earliest of the larger species to come out of hibernation, and the earliest specimens found betray its winter habits. The animal buries itself from five to six or more inches in the soft soil of moist hillsides, to issue forth when first the warm rays of the vernal sun penetrate to its hiding place. In the vicinity of Indianapolis the species is said to be abundant, while in southeastern Indiana and around Cincinnati it is most abundant. I have taken four thousand, and over, specimens

of this species in a single afternoon on the slopes of the hills facing the Little Miami River, near Cincinnati! To one who has never collected this species in its metropolis the great numbers found, under leaves and partly buried, an inch or two, in the soft soil, will almost pass belief. Many albino examples, that is, without lines of color, have been taken and are in the Call Collection, in Harvard University. A few were found entirely wine-colored, being a rich, deep red. Some were found whose greater diameter exceeded 35 mm., while there is a very great variation in height. In all old specimens the shell is greatly wrinkled, coarsely so, about the apertural opening. In most cases of mature shells the aperture has been broken and repaired, very few having escaped injury of this kind. No other shell can be mistaken for it.

PATULA ALTERNATA Say. Plate 5, figs. 2, 3.

Shell broadly umbilicated, orbicularly depressed, thin, smoky horn color, varied with red, interrupted, obliquely arranged patches and spots, roughened by crowded, elevated, rib-like striae, smoother below; whorls five and one-half, flattened, the last sometimes obtusely carinated at its periphery; umbilicus large, pervious; aperture very oblique, lunately rounded, banded within; peristome simple, acute, its terminations joined by a very thin, transparent callus, that of the columella subreflected. (Binney.)

This is the most common shell and the most widely distributed one in Indiana. It is found in almost every conceivable station, even where all other forms are absent, but loves best hillsides with old timbers, sticks, stones, and similar debris. Under flat rocks it often congregates in great numbers in the late fall, when the frosts come, and hibernates in such situations. The species is gregarious, and when one specimen is found others will almost certainly be secured.

Many animals of this species are reddish, and when collected, exude a reddish and abundant mucus from the aperture. The color patches are highly characteristic, and no other Indiana shell shares this feature. Numerous specimens have been taken which are entirely white, while others of a deep cream color have been found; occasionally a wine colored one may be found. There is a great variation in the coarseness of the ribs which mark the surface, occasional specimens being found which are almost smooth. Carinated specimens often occur, and sometimes races of these carinate varieties are found; they have been separately described under the name of *Patula mordax*. While the shell is very common, it is also one of the prettiest we have and attains a size somewhat greater than that given by Mr. Binney,

who says the greater diameter is 21 mm.; I have numerous examples which are over that dimension. Attention should also be called to the variation in height, which is considerable, one race of high-spined forms having been recently given a new name by a Philadelphia naturalist. Many have been collected by me which are very flat, ranging to extreme conical forms, all on the same hillside, at Cincinnati, Ohio.

PATULA PERSPECTIVA Say. Plate 5, fig. 4.

Shell broadly and perspectively umbilicated, orbicular, scarcely convex above, excavated below, thin, reddish horn-color, regularly ribbed; whorls six and one-half, gradually increasing; aperture small, lunately subcircular; within furnished with a single, subprominent tooth on the base of the shell; peristome simple, acute, its extremities separated widely. (Binney.)

This is a very small species, and has been found by me in Indiana only at Madison, Corydon and Lawrenceburg. It is easily distinguished from its small congener which also has wider distribution, by the wide and perspective umbilicus. Its deep red color will also serve to distinguish it. The habitats of this form are not so general as those of other shells, but it selects drier stations and is commonly found under dead trees, under the bark, close to the ground, or between the bark and wood. It is occasionally found under flat stones. Southern Indiana is by no means the metropolis of this species, but is rather on the northern limit of its distribution. Tennessee and Kentucky furnish hundreds of examples in all suitable places.

PATULA STRIATELLA Anthony. Plate 4, fig. 3.

Shell umbilicated, orbicularly convex, thin, brownish horn-color, with crowded ribs; whorls four, scarcely convex, the last inflated below, rather wide; umbilicus large, pervious; aperture subcircular; peristome simple, acute, its terminations approached. (Binney.)

This little shell occurs on moist sand flats, with vegetation, in river and creek bottoms, under old logs, trees, and even under stones, in damp stations, and usually in numbers. After a warm rain it may be found crawling around on the moist sands of creek bottoms, or crawling on the upper surfaces of fallen logs, but always in stations of considerable moisture. It is much less widely umbilicated than the preceding form, and the sculpturing of the surface easily aids in separating it. I have collected it at Indianapolis, Madison, Corydon, Evansville, Bloomington, Wabash, and Lawrenceburgh. It doubtless occurs all over the State.

HELICODISCUS LINEATUS Say. Plate 4, figs. 5, 6.

Shell widely umbilicated, discoidal; epidermis greenish; whorls about four, visible on the base of the shell as well as above, with numerous equidistant, parallel, raised lines revolving upon them; suture much impressed; aperture remote from the axis, semi-lunate, narrow, not expanding; peristome acute, thin; umbilicus wide, forming a concave depression of the base, each volution visible to the apex; within the aperture, on the external circumference, are placed from one to three pairs of minute, conical, white teeth, the first pair in sight when looking into the aperture, the others more remote. (Binney.)

The very flat appearance of this shell will at once attract attention and serve to distinguish it. It is common, but not abundant, in most parts of the State, under bark, in cracks or creases of bark on fallen trees, and sometimes under stones. The little teeth within the aperture are also a highly characteristic mark. At Lawrenceburgh and Madison a number of examples were taken in the spring of 1895 and 1896.

STROBILA LABYRINTHICA Say. Plate 5, figs. 5, 5a.

Shell umbilicated, globose-conic, brownish-horn color, with stout ribs above, and below lighter, with arborescent wrinkles; spire obtuse; umbilicus narrow, pervious; aperture scarcely oblique, lunately rounded; peristome briefly reflected, thickened; parietal wall with three revolving, deeply entering, parallel laminae, the central further within the aperture and less developed, and around the axis one stout, lamella-like rib, not reaching the columella; on the base of the outer whorl are two short, deeply seated, internal revolving, rib-like laminae. (Binney.)

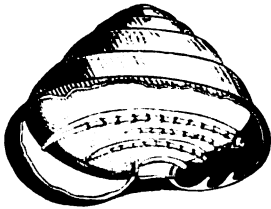


Fig. 3.

This little shell is sometimes confounded with *Zonites* (*Conulus*) *fulvus*, but is distinguished, in mature specimens, by the slightly reflected lip, or peristome. The younger forms may also be distinguished by breaking away the outside whorl when the characteristic parietal laminae will be seen as narrow bands of white. The external texture of this species is much coarser than that of *Z. fulvus*.

This is by no means an abundant shell, but is common. It is to be sought under old logs, trees, between the bark and wood of half-rotted logs, and in similar situations, but usually in the woods. It is rare indeed to find specimens far from the edge of the forest.

STENOTREMA STENOTREMUM Férussac. Plate 5, fig. 6.

Shell imperforate, globose, diaphanous, reddish, hirsute, convex above, inflated below; spire elevated; whorls five, somewhat convex, the last anteriorly gibbous, angularly deflected; aperture irregularly transversely lunar, almost linear, contracted by a long, stout, elevated lamelliform tooth along the whole length of the parietal wall, furnished far within, on the base of the last whorl, with a transverse tubercle, springing from the axis; peristome scarcely expanded above, thickened by a heavy, regularly curving callus, its basal margin with a small notch. (Binney.)

The aperture of this species is frequently purple colored, especially on the inner margins of the narrow opening. The hairs which cover the epidermis are short and thick, and rather stiff, and are arranged in regular lines. Smooth specimens are never found with a perfect epidermis, but in old age many or most of the hairs are lost except in the region of the sutures, where they are protected against rubbing. I have found this species at only two localities in southern Indiana, Madison and Lawrenceburg. It is likely to be found all over the southern half of the State. The chief character which at once distinguishes it from any other Indiana *Stenotrema* is the notch near the umbilical region of the lower lip and by its larger size. The only other form it is likely to be confounded with is *Stenotrema hirsutum*, which is, however, a much smaller shell. This shell must be looked for under wood, chips, bark and similar debris, and commonly remains clinging to them when they are overturned. It is a solitary species, rarely more than one or two being found under the same log.

STENOTREMA HIRSUTUM Say. Plate 5, fig. 7.

Shell imperforate, subglobose; epidermis brownish or chestnut, covered with numerous, sharp, rigid hairs; whorls five, rounded; suture distinct; aperture contracted, very narrow, almost closed by an elongated, lamelliform tooth situated on the parietal wall and extending from the center of the base, within the junction of the peristome with the outer whorl, into the edge of the aperture; peristome narrow, very much depressed, and reflected against the outer whorl, with a deep cleft or fissure near the center of the basal margin; umbilicus wholly covered; base convex; far within the base of the shell is a transverse tubercle, starting from the axis. (Binney.)

This is an abundant form all over southern Indiana, and has been taken as far north as Indianapolis and North Manchester. It may occur still farther northwards. It is to be sought under flat stones

on hillsides, under bark, logs and fallen trees, and under leaves on damp hillsides, close to the ground. The shell is commonly thickly covered with minute small, straight hairs, which are not shown in the figure, and entangled in these hairs is so much mud and dirt that the animal often escapes observation. The notch is quite near the basal or umbilical end of the aperture, while the apertural opening is exceedingly small. The animal is slate colored and is very active.

STENOTREMA MONODON Rackett. Plate 5, fig. 8.

Shell imperforate, or umbilicated, globose-depressed, diaphanous, reddish horn colored, covered with short hairs; spire rather convex; whorls five and one-half, the upper ones flattened, the two last convex, the last anteriorly gibbous, constricted at the aperture; umbilicus more or less opened or completely closed; aperture widely lunar, somewhat narrowed by a lamelliform



Fig. 5.

tooth on the parietal wall; peristome acute, reflected, thickened with white callus within; a transverse internal tubercle on the base of the shell. (Binney.)

This species is widely distributed all over Indiana, and may be expected to occur where land shells are found at all. Its favorite hiding places are under logs, old stumps, and under flat stones, in all possible situations, sometimes even in the open fields. Many specimens are very small, about one-half the size ordinarily attained, and to these the name of *Stenotrema leaii* has been given, but it is properly only a de-pauperate race. Another rather smaller form than the type occurs under logs and sticks, often in open fields, to which Say gave the name of *Helix fraterna*, describing it from Pennsylvania.

Say's description of *Helix fraterna* is now rare, having been published in "A Narrative of an Expedition to the Source of the St. Peter's River," Vol. II, p. 6 of Appendix, figured on plate 15, figure 3. Because of this fact it has been deemed best to reproduce his original description, which now follows:

"*H. fraterna*. Shell convex, brownish horn-color, minutely hirsute; whorls five, rounded; umbilicus partially or entirely closed by the termination of the labrum; region of the umbilicus indented; aperture much contracted by the labrum; labrum reflected, white, unarmed; its outer edge not projecting beyond the curve of the whorl; its inferior angle extends to the center of the base of the shell; labium with a strong, prominent, oblique, compressed, white tooth. Breadth, one-third of an inch. Inhabits Pennsylvania."

The young of this species is very thickly covered with hairs which entangle many small particles of mud, and which must be removed to

discover the real color of the epidermis. In those specimens in which the peristome has not yet been reflected a rather deep violet or reddish color may be noticed which becomes less conspicuous with age. There is a wide range of variation in the character of the umbilicus; in some specimens that structure is entirely open, and in others partially or entirely closed. These differences are not, as some have supposed, of specific value, but only indicative of a wide range of variation. The typical form of *Stenotrema monodon* is gregarious. I have taken under a large single log, in the flatlands along the Rock River, near Rock Island, Illinois, several hundred fine examples; under other pieces of drift wood in the immediate vicinity many other examples were taken at the same time. It is a very common form all over the Central West.

TRIODOPSIS PALLIATA Say.

Shell with the umbilicus closed, thin, depressed; epidermis dark brown or chestnut-color, and rough with minute, acute projections and stiff hairs; whorls five, flattened above and rounded below, with numerous very fine, oblique striæ; aperture three-lobed, much contracted by the peristome and teeth; peristome white, sometimes edged with brown, widely reflected, with two projecting teeth on the inner margin, the one near its junction with the body-whorl acute and prominent; the other, on the basal portion, long, lamellar, and but little prominent; parietal wall with a very prominent, white, curved tooth, projecting nearly perpendicularly from the shell, and forming one boundary of the aperture; umbilicus covered with a white callus, the continuation of the reflected peristome; base convex. (Binney.)



Fig. 6.

Large examples occur in southern Indiana that measure over 30 mm. in diameter. The entire shell is sometimes rufous, while the aperture is almost or quite purple, but it is commonly white. Under old trees and under flat stones on moist hillsides this form is likely to be found in some abundance. The writer has collected it at Corydon, Madison, Lawrenceburg, Brookville, and has seen it from several other places within the State. It probably occurs all over Indiana, but will be found to be more common in the southern portions of the State.

The animal is a dark slate color and when crawling is very narrow, with foot pointed behind. It usually leaves an abundant trail of mucus in its path. The outer lip of the peristome has, on its inner margin, two large and thick deposits of calcareous matter which, in some specimens, almost entirely closes the aperture, leaving only a thin and narrow opening. Through this the animal extrudes itself, without

apparent difficulty. In most old specimens the stiff hairs of the epidermis are broken off, but in specimens in which the lip has just formed and the peristome been well reflected the hairs are present and are numerous and characteristic. Numerous pathologic individuals are found on hillsides where the species frequents rocks. Then the aperture is often distorted and other peculiarities are apparent.

TRIODOPSIS OBSTRICTA Say. Plate 5, fig. 10.

Shell with the umbilicus closed, depressed, with heavy, rib-like striae and interstitial, minute, revolving lines, reddish horn color; spire flattened; whorls five, depressed, the last convex below, with a prominent, acute carina above; aperture oblique, subtriangular, narrowed by a tongue-shaped, arcuately entering tooth on the parietal wall; peristome thin, broadly expanded, its inner edge with a heavy thickening of white callus, its right portion with a stout, erect denticle, its basal portion straight, dilated, reflected, with a long, lamellar, less prominent denticle. (Binney.)

I have not personally collected this species in Indiana, nor have I ever seen an Indiana specimen, but introduce the form in this catalogue because Mr. Binney has given Indiana as a habitat for it. It resembles *Triodopsis palliata* quite closely except in the sharp carina with which *T. obstricta* is marked. It has, at least in the young form, abundant minute, short hairs, but it is far more coarsely striate than is *T. palliata*. It is a southern form and finds greatest expression in the shell fauna of east Tennessee and Kentucky; its metropolis appears to be among the Cumberland Mountains. The sculpturing of the upper surface will readily serve to separate it from any other form found in Indiana.

TRIODOPSIS APPRESSA Say. Plate 5, figs. 11, 11a, 11b.

Shell with the umbilicus covered, orbicularly depressed, pellucid, with rib-like striae and minute revolving lines, reddish horn-colored; spire flattened; whorls five, flattened above, the last obtusely angular (the angle obsolete anteriorly); aperture oblique, compressed, subtriangular; peristome angularly broadly reflected, thickened within, its terminations joined by a thin callus, on which is an obliquely entering, erect, curved, tongue-shaped tooth, the basal margin with a lamellar-like, long denticle, the right margin sometimes with an erect, tooth-like callus. (Binney.)

This shell is often light horn-colored, rather than reddish, and is by no means abundant in Indiana. I have taken it at Brookville, Lawrenceburg and Madison, and have seen specimens which came from

other portions of the State, but all of them were from the southern portion. In Kentucky and Tennessee the form reaches its greatest development, both in respect to size and numbers. It is commonly found under flat rocks on wooded hillsides. Very young specimens have an abundant development of hairs on the epidermis, but these all appear to be lost after maturity. It more nearly resembles *Triodopsis palliata* than any other of the genus, but is very distinct.

TRIODOPSIS INFLECTA Say. Plate 5, fig. 12.

Shell with the umbilicus closed, depressed; epidermis brownish horn color, with very fine, hair-like projections; whorls five, with very minute, transverse striæ; suture not much impressed; aperture three-lobed, very much contracted; peristome white, narrow, reflected, with a deep groove or indentation behind the reflection, contracting the opening so that the outer edge of the peristome does not project beyond the surface of



Fig. 7.

the whorl; on the inner margin of the peristome are two acute teeth with the points directed inwards, one near the base, the other midway between that and the junction of the peristome with the body-whorl, with a circular sinus between them, forming one of the lobes of the aperture; parietal wall with a long, arcuated, white tooth; umbilicus covered, its place considerably impressed. (Binney.)

This little species, which attains a diameter of about 10 to 12 mm., is very common over all of southeastern Indiana. At Madison and Lawrenceburg, as well as at Brookville, I have taken it in abundance. It is common on stony hillsides under flat rocks, but is also taken in numbers in wooded tracts under logs and sticks. It is abundantly covered with minute hairs.

TRIODOPSIS TRIDENTATA Say. Plate 5, figs. 13, 13a.

Shell umbilicated, orbicularly depressed, with crowded, rib-like striae, light horn or chestnut-colored; spire very short; whorls five and one-half, rather convex, the last scarcely deflected in front; aperture lunar, subtriangular; peristome white, reflected, its outer contour rounded, thickened within, its terminations converging, joined by a light deposition of callus, bearing a tongue-like, erect, entering tooth, both the right and basal portions bearing on the inner margin a stout, acute denticle. (Binney.)

This is an exceedingly abundant shell all over Indiana and especially so over southern parts of the State. It is found in a variety of situations, under logs, sticks, bark, stones, and under leaves on damp hillsides. There is a very beautiful variety common in Eden Park,

Cincinnati, under the flat stones of a quarry on its eastern edge, which is characterized by its smoothness and light horn color. It is found in collections under its proper name, but is almost entitled to rank as a variety. The typical form is rare in this locality. On one occasion, under flat rocks, in early April, 1896, I collected several thousands of this species in the locality above named, where it is the most abundant shell. With it were associated large numbers of *Triodopsis appressa*. In Indiana I have found the form to be abundant. On the hillsides above Madison are to be found large numbers, and in Dearborn County it occurs nearly everywhere. Many specimens quite white occur, and seem to indicate that epidermal coloration can not be regarded as having any specific value.

Near Milan, in a small ravine which crosses the roadway leading to Moore's Hill, and at North Vernon I collected a small form of this species which certainly was not half the size the shell usually attains; these specimens are now in the Call collection in the Museum of Comparative Zoology, Cambridge.



TRIODOPSIS FALLAX Say. Plate 5, fig. 14.

Shell umbilicated, depressed-globose, with rib-like striae, reddish horn-colored; spire convex; whorls six, rather convex, the last deflected anteriorly, constricted; aperture trilobed, contracted by a large, oblique, tongue-shaped, arcuately entering tooth on the parietal wall; peristome reflected, thickened within, white, with two teeth, the upper one bending inward not on the edge, the other sub-basal. (Binney.)

This shell is closely allied to the preceding, and I do not think ought to be separated from it. It is one of those survivals in zoology which, however, one must suffer. There is no difference in habitat, in color, in general markings, or in the genitalia which justifies separation. The chief character which collectors rely on that serves to distinguish it from *Triodopsis tridentata* is the narrow constriction just behind the margin of the aperture; the six full volutions alone are not of specific value, for the nearly allied form above mentioned sometimes has that many! It would be far more to the point to indicate the resemblances, rather than the differences, and put this name as a synonym under *T. tridentata*, where it properly belongs. It has the same general habitats, is found under the same conditions, and occurs in all collections made on any day in the woods of southeastern Indiana. It is supposed to be a little more elevated in the spire than its near ally, but as this is a very variable feature almost any form may be selected from a number of individuals.

MESODON ALBOLABRIS Say. Plate 5, figs. 15, 15a.

Shell imperforate, convex; epidermis immaculate, of a uniform yellowish-brown russet or light chestnut color; whorls five to six, with fine parallel striæ running obliquely across them, and spirally striated with very minute and delicate, but distinct, wavy, impressed lines, which are most apparent on the back of the reflected peristome; suture well marked and distinct; aperture contracted by the peristome; peristome white, flattened in the plane of the mouth, abruptly and very widely reflected;

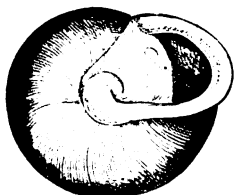


Fig. 9.

umbilicus of the mature shell covered by the reflected peristome, which is continued to the base of the shell. (Binney.)

This is the largest species with reflected peristome to be found in Indiana, and is a highly characteristic shell. It is found in open woodlands, and on wooded hillsides, under logs, or crawling over the ground in the shelter afforded by the thick vegetation which abounds on wet hillsides. After a warm rain this species, and indeed all of the species of the subgenus *Mesodon*, come out and crawl freely about, and such times are the best in which to collect them. They may be found in æstivation, clinging to the under sides of fallen logs, not buried in the ground, with a thin membrane, the epiphragm, which is the dried mucus secreted across the aperture, closing it against further loss of moisture by excluding the air. This same secretion glues them, lightly, to trees, and is always ruptured when they are taken.

This species occurs over all of Indiana, but is largest and most perfectly developed in the lower Wabash Valley and along the Ohio. It is abundant at Madison, Corydon, Bloomington, Lawrenceburg, and Brookville; on the northern slopes of the Kentucky hills facing the Ohio, opposite Madison and Lawrenceburg, this shell is found in great numbers and in great perfection. Among many there collected were a large number of the mahogany or light coffee-colored forms, with pink aperture. Many specimens had the parietal tooth well developed, a feature which is seen in about five or six specimens in a hundred, but in these localities the dentate forms seem to be abundant. It will be noticed by the collector that only the old forms present this character, which gives origin to the subgeneric name. Most of the specimens which I have taken have a reddish or cream-colored animal; I have never seen an animal of this species which was black, or anywhere near black, though Mr. Binney declares the animal varies to blackish.

The eggs of this species are easily collected for study and are found under logs, in moist situations, deposited in clusters or clumps of two

or three dozen, or more. I have had them deposit their eggs in captivity, in cigar boxes, pending opportunity to remove the animal from the shell. The eggs are very large and somewhat cream-colored. Perhaps it should be here mentioned that the forms with almost white epidermis are the most common in Indiana, russet-colored ones being rare.

MESODON MULTILINEATUS Say. Plate 5, figs. 16, 16a.

Shell imperforate, depressed-subglobose; spire convex, rather thin; epidermis yellowish brown or russet color, with numerous reddish brown, finely undulated, revolving lines and bands; whorls between five and six, convex, with delicate, parallel, oblique striae, the last ventricose; suture distinctly marked; aperture lunate, slightly contracted by the peristome; peristome white, not much expanded, reflected, rather thin; umbilical region depressed (Binney.)

This species has been found in suitable localities all over southern Indiana and as far north as North Manchester. About Brookville, Indianapolis and Edinburg it is very common. The greatest variety in coloration is seen on examination of large series of specimens. This is essentially a species of the lowlands and delights in swampy and moist stations. The margins of bogs which have a bordering of bushes and trees that furnish, when the leaves fall, a good protection are excellent places in which to collect them. In the swampy or boggy places that mark so much of the bottom lands of the Wabash this species occurs in numbers. It is usually found crawling about, even in the warm sunshine, and appears to withstand the summer's heat better than does the majority of helices. I have seen many albino specimens and also a number which were entirely wine-colored, there being only a general uniformity in color pattern. The number of narrow color bands will serve to separate this species from all other mesodons. In its winter habits it appears to be gregarious where it occurs at all, many examples being sometimes collected together in a single mass. It is one of the commonest of forms in river drift, and, in these situations, the epidermis is usually peeled off, when the color bands are seen to be in the mass of the shell and not epidermal in character. I have collected this form in the loess of Iowa and Illinois, and also noted it in the loess at Vicksburg, Mississippi. Its wide distribution shows that it has long formed an integral part of the shell fauna of eastern North America. Rare individuals are found which have the central parietal tooth, but they are very uncommon.

MESODON PENNSYLVANICUS Green. Plate 6, fig. 1.

Shell imperforate, convex, elevated; epidermis yellowish horn color or russet; whorls six, convex, with crowded, elevated, oblique striae; suture distinctly marked; aperture subtriangular, contracted by the peristome; peristome white, narrow, reflected, not flattened, with sometimes a slight thickening on the inner side near the base; umbilical region indented. (Binney.)

This species has occurred in my collecting only at Lawrenceburg and Brookville, in southeastern Indiana. It is fairly common at the latter place and rare at the first named. Around Cincinnati, in favorable localities, it is common, a hundred being collected in one spot a few feet square in a single afternoon. It is one of the three small species of *Mesodon*, but is quite easily distinguished from the others by its greater solidity, the shell being much thicker and heavier. The peculiar shape of the aperture, due to a thickening on the lower portion of the peristomal margin, will also serve to separate it. Its usual habitat is on hillsides, in grass which is thickly covered with leaves, on the margins of forests or in open forests. It is found in contact with the earth, commonly in a snug little hole made in the ground. The color of the epidermis is by no means a constant feature, but ranges from very light horn color to a fairly dark russet. A feature which the collector will not enjoy is the tenacity with which the animal adheres to the shell even after the usual boiling process employed to remove it. Nearly half the animals break off in trying to extract them.

MESODON MITCHELLIANUS Lea. Plate 6, fig. 2.

Shell imperforate, depressed, conoid-globose, thin, with crowded, striae and very crowded, decussating, microscopic lines, pellucid, horn-color, polished; spire briefly conoid; whorls five, moderately convex, gradually increasing, the last ventricose, subconstricted and briefly deflected anteriorly; aperture diagonal, lunate, subperlaceous within; peristome white, thickened, its terminations slightly converging, subequally reflected, that of the columella narrow, adherent, or subdilated and spreading. (Binney.)

This is a rather small species, the smallest of the group in Indiana. I have noticed it only in southeastern Indiana, about Brookville, where it is found on a low hillside on the borders of a swampy area near the Whitewater River. About Cincinnati, Ohio, it is common enough, but does not appear to be very widely distributed. It is a very beautiful little shell, with bright and shining epidermis, and is very light-colored in all the specimens which I have seen. It should be looked for

in rather low or damp ground, in grassy stations; after heavy warm rains it often ascends the stems of plants and may be found clinging to the lower surfaces of the leaves. It is not easily confounded with any other form except *Mesodon clausus*, depauperate specimens of which I have frequently received under this name.

MESODON CLAUSUS Say. Plate 6, figs. 6, 6a.

Shell subimperforate, conoidly semiglobose, rather solid, with crowded, rib-like striae, yellowish horn color; spire subregularly conoid; whorls five and one-half, rather convex, gradually increasing, the penultimate subangular, the last rounded, anteriorly subconstricted, and briefly deflected; umbilicus narrow, almost covered by the reflected peristome; aperture diagonal, subregularly lunate; peristome with a heavy white thickening, uniformly subangularly reflected, its columellar portion subdiluted. (Binney.)

This is a widely distributed species in Indiana, ranging from Covington, Wabash and North Manchester over all the southern portion of the State. It is whiter than *Mesodon pennsylvanicus* and larger than *Mesodon mitchellianus*, but is closely related to them in all essential characters. It is found in a variety of habitats, but best loves low ground where are abundant growths of weeds. After heavy storms it may frequently be taken clinging to stems and the under side of leaves. It is very active and crawls about in the grass of damp stations very freely, even in fairly dry weather. It is a delicate and graceful shell, less heavy than the larger *Mesodon pennsylvanicus*. It is abundant over all of southeastern Iowa, southern Illinois as far north as Rockford, and abounds in all the river counties of Indiana. It is also abundant in the Wabash Valley as far north as Covington, and probably ranges to the northern boundary of the State. Mr. A. W. Butler and Professor H. S. Voorhees have sent me fine examples from Brookville, where I have also collected it. On the Kentucky side of the Ohio it is abundant in favorable localities and is rather larger than common. Occasional specimens have been found that were over 20 mm. in diameter. I have never seen a specimen, in all the hundreds I have collected, with a parietal tooth.

MESODON ELEVATUS Say. Plate 6, fig. 3.

Shell imperforate, very convex, elevated, almost conical; epidermis yellowish horn color; whorls nearly seven, rounded, with fine, oblique, transverse striae, the last ventricose; suture distinct; aperture contracted by the peristome, somewhat triangular; peristome white, thick-

ened, reflected, its basal portion with an obsolete, lamellar denticle; parietal wall with a large, white, robust, obliquely curved tooth; umbilicus covered. (Binney.)

Shells of this species may be found all over Indiana, but its metropolis is in the river counties on the south. In favorable localities on hillsides it is a most abundant shell, hundreds being collected in an hour or two on favorable days. The large size of the shell, its high, conical shape, and the very heavy oblique parietal tooth will readily distinguish it at once from all other mesodons. There is a great variety of shape to the aperture, and in many old shells there is a thickening of the peristome towards the basal margin that no other closely related form seems to have. This is one of the earliest shells to come out of winter quarters and, since it burrows far into the mud of wet hillsides, when it emerges it is heavily coated with mud and dirt. It burrows as deeply as six or seven inches. It is always found crawling, even in dry weather, on its favorite hillsides, but after a warm and heavy rain it comes out in swarms. Early morning, or late evening, will disclose hundreds of this animal, and it can then be collected in great numbers. On the hillsides of the Ohio, on the Kentucky side, opposite Lawrenceburg, and opposite Madison, it is very abundant, associated always with the following species, which is also abundant. I have taken a number at Bloomington, on Bean Blossom Creek, on the wooded hillsides, where it is common but not so abundant. The fall is the most favorable time to collect this shell, since those which survive the winter and come out in the early spring are devoid of much of their epidermis.

MESODON EXOLETUS Binney. Plate 6, fig. 4.

Shell imperforate, convex, somewhat ventricose; epidermis of a uniform yellowish horn or russet color; whorls between five and six, with fine parallel striae crossing them obliquely; body whorl large and ventricose; suture well marked and distinct; aperture rounded, contracted by the peristome, the plane of the aperture making a considerable angle with the plane of the base; peristome thickened, white, reflected, its basal portion subdentate; parietal wall with a prominent, white, oblique tooth; umbilicus covered. (Binney.)

This species is common over all the southern two-thirds of Indiana, and is especially so in the wooded bluffs along the Ohio River. At Madison and Lawrenceburg it is very abundant, and is scarcely less so in the bluffs along the creeks at Corydon. It is always found in association with *Mesodon elevatus*, but is easily distinguished from that form by its more flattened spire, somewhat greater diameter, and

the entirely different character of the parietal tooth, which is never so large and thick or so much curved as in *M. elevatus*. The animal is often yellowish to ashy gray in color and extrudes itself far from its shell in crawling about. The habits are not essentially different from those of the preceding species, but it appears to bury itself some deeper in the loose soil of hillsides when it goes into winter quarters. Binney calls attention to the habit of this species in laying its large eggs, in clusters, deeply into the earth, "as deep as the body of the animal will extend." On damp or very moist hillsides, of a springy nature, this shell may be found in abundance.

MESODON THYROIDEUS Say. Plate 6, figs. 5, 5a, 5b.

Shell narrowly umbilicated, depressed globose; spire convex; epidermis of a uniform yellowish-brown or russet color; whorls five, with fine parallel striae running obliquely across them; spire more or less elevated; suture distinctly impressed; aperture lunate, contracted by the peristome, the plane of the aperture making a considerable angle with the plane of the base of the shell; parietal wall with a prominent, white, tooth-like process placed obliquely to the axis of the shell; peristome white, thickened, widely reflected, and sometimes grooved on its face, its exterior yellowish; umbilicus exhibiting only one volution, partially covered by the reflected peristome where it unites with the base of the shell. (Binney.)

I have found this species to be the most widely distributed *Mesodon* in Indiana, since it ranges all over the State. It is one of those forms which may always be found in low, marshy stations, under leaves bordering swamps, in the low bottom lands of streams like the Wabash in its lower part, and on wet hillsides where abundant plants grow. In southeastern Indiana it is found everywhere where snails can be expected to occur at all. The animal is yellowish-white, sometimes almost brown, and is very active. The eggs are laid in either the moist earth or under leaves next the ground, or under fallen trees and logs. This species also may be found on fairly dry hillsides under flat stones or clinging to trees in bottom lands at a height of from two to six feet above the ground. It sometimes may be taken in alder swamps, attached to the leaves of the plants, on the under side. It is an active species after rains and may then be taken as it crawls around in numbers. The epidermis ranges in coloration from rather dark reddish to white, and is beautifully polished. Its umbilicus, always present, will aid in distinguishing it from all others of the subgenus.

MESODON PROFUNDUS Say. Plate 6, fig. 7.

Shell broadly umbilicated, orbicularly depressed; epidermis yellowish horn color, with reddish-brown revolving lines and bands, sometimes uniformly brown or albino; whorls from five to six, convex, obliquely striated with delicate and regular raised striae; suture distinct; aperture almost circular, a little contracted by the peristome, flattened towards the plane of the base; peristome white, thickened, reflected, with a slightly prominent callus or obtuse tooth on the inner edge near the base; umbilicus rather large and profound, exhibiting all the volutions to the apex; base convex, with the striae converging into the umbilicus. (Binney.)

This is an easily distinguished species. The bands of color are usually two in number, but sometimes there are three or more; occasionally all are merged into one when a deep reddish or brownish color is given to the whole shell. Albino specimens are very common. At Bloomington, Brookville, Indianapolis, Madison, Corydon and Lawrenceburg, as well as over all the lower Wabash Valley, this is a most common species, in the same stations as are occupied by *Mesodon elevatus*, and *Mesodon exoletus*. The thickening of the peristomal margin, near the base, is highly characteristic, while the coarse striae make the surface quite rough, more so than is the case with any other Indiana shell.

This species also has the habit of climbing far up on the sides of trees in the low lands, fastening itself by the epiphragm. I have taken specimens as high as 10 feet above the ground. I have received the immature shells under the name of *Patula solitaria* from a number of correspondents, but the plain marks of juvenility should serve to separate it from immature, or mature, shells of that species. The eggs are laid similarly to those of *Mesodon elevatus*, and number thirty or more, cream-white in color, and nearly one-tenth of an inch in diameter. The size of the eggs rapidly changes after a day or two as the development processes progress; the size I have indicated is that of freshly laid eggs.

VALLONIA PULCHELLA Müller. Plate 4, fig. 9.

Shell widely umbilicated, depressed, slightly convex above, thin and transparent; epidermis colorless; whorls four, very minutely striated, the last large and spreading at the aperture like a trumpet; aperture orbicular, a little dilated; peristome much thickened, white, reflected, making nearly a continuous circle, ends approaching; umbilicus large, exhibiting all the volutions. (Binney.)

This is a most abundant species in southeastern Indiana, in suitable locations. I have found it abundantly at Lawrenceburg in debris of gardens along fences and even at the base of grass clumps in the open lawns. It is an introduced species, or is circumpolar. It is very minute and should be confused with no other likely to be found in the State. The reflected aperture is a feature which no other small flat species shares. The diameter of the shell is from two and one-half to 3 mm. After a rain the weeds and dead sticks which are found along the margins of most gardens will be found to have hundreds of these tiny shells adhering to them. I have never found it in the woods, though I suppose it so occurs. Almost nothing is known of its habits and nothing of its embryology. It doubtless occurs over all of the State. It is a most abundant shell in Eden Park, Cincinnati, the dirt collected under bunches of dead stems of plants, when sifted, containing hundreds of examples.

The collector will not fail to observe that the markings of the shell range from perfectly smooth and shining to strongly ribbed or costate forms. To the costate shells the name of *Vallonia costata* has been given, but no careful observer will now separate them. Every variety of sculpturing may be seen in a quantity taken from the same locality.

FAMILY PUPIDÆ.

PUPILLA PENTODON Say. Plate 6, figs. 8, 8a.

Shell subperforate, of an elongated-ovate form, minutely striated, and of a spermaceti or whitish horn color; whorls about five, well rounded, and separated by a deep suture; apex rather acute; aperture oblique, nearly semicircular; peristome sharp and somewhat expanded, but not reflexed; the submargin of the throat is thickened by a ridge of white callus on which the denticles are situated; one of these, and sometimes two, is on the parietal wall, two on the columella portion of the peristome, and two constantly, and from one to five others occasionally, on the outer portion of the peristome; of these, that near the middle of the parietal wall is largest, that at the upper part of the columella is next, and one opposite the first, on base of the aperture, is the third in size. (Binney.)



Fig. 10.

All the members of this family are very minute and are to be collected with difficulty and only after careful search. This species in particular may be found all over Indiana, under bark, logs, fallen

trees, and often under flat stones, on the edges of forests and in the open lands in river bottoms. It is also to be found in gardens, about dwellings, under old boards, stones, and under refuse piles of plant stems. A most favorable time to collect this and other very small species is after a rain, on the upper sides of the fallen trees, in well shaded bottom lands, such as those of the lower Wabash. It may then be found in numbers crawling along on the bark, having been driven from the cracks and crevices by the water. The shells are often coated with mud, especially when taken from under logs and sticks, and are then with great difficulty distinguished from mere little mud-lumps, or from the small earthy pellets or castings from earthworms. Several species and varieties have been based on the variable characters of the little denticles within the aperture, but they have no valid basis in structural differences, and rather lead to confusion than to a better understanding of these delicate and small objects. I have the species from Indianapolis, Lawrenceburg, and North Manchester.

LEUCOCHILA FALLAX Say. Plate 6, fig. 9.



Fig. 11.

Shell fusiform, regularly diminishing in volume from the body-whorl to the apex, smooth; epidermis brownish horn-color; whorls six, very convex, striæ of growth hardly apparent; suture well impressed; aperture lateral, rounded-oval; peristome white, rather broadly reflected, lined within with white callus, its right termination strongly curved; umbilicus perforated. (Binney.)

This little shell, which is from five to five and one-half mm. in length, is unlike any other found in the State. It is common over all of the southern half of the State and likely occurs to the northward. It is a beautiful mahogany-brown species, and has a glistening epidermis. It is found at the base of grass clumps in gardens and lawns, and under chips, sticks, flat stones, and occasionally leaves in woods. It can not be confused with any other member of the family. The rimate character of the aperture, its transverse striae, and the absence of denticles in the aperture or on the throat will serve to distinguish it at once. The animal is entirely black.

LEUCOCHILA ARMIFERA Say. Plate 6, figs. 11, 11a, 11b, 11c.

Shell cylindrical, subfusiform, smooth; whorls six to seven, convex, the three next the aperture of about equal diameter, the posterior three diminishing and forming a rather obtuse apex; suture impressed; peristome white, thin, subreflected, forming the whole outline of the aperture, except a small portion of the body-whorl, where a thin, testaceous deposit connects its two extremities; aperture lateral, nearly

oval, deep, cup-shaped, and narrowing towards the throat, which is almost filled up by projecting teeth, white within; teeth commonly four, one of which, affixed to the body-whorl, commences at the superior margin of the aperture, near the junction of the peristome and ultimate whorl, and runs backward and downward into the aperture; it is prominent, lamelliform, irregular, has one or more sharp, projecting points, and is sometimes bifid; another, thick and massive, is situated deep in the throat, and marks internally the place of the umbilicus, and two others, projecting and tooth-like, are placed on the peristome at the base of the aperture, and point towards the center of the aperture; base of the shell, from the umbilicus to the edge of the aperture, compressed, forming a short and obtuse keel; umbilicus a little expanded and slightly perforate. (Binney.)

From this description it may be seen that there is a great degree of variation in the arrangement and characters of the denticles which partially close the aperture of this species. The shell itself is not separated by these characters, which are but trifling at most, from other small forms, but is easily distinguished by the outline of the shell and its size, being the largest of the Indiana *Pupidæ*. The epidermis is always white. The species is very common and is found in almost all stations, but especially is likely to occur under flat stones, on wooded hillsides. I have taken it on my lawn in Lawrenceburg, in great numbers, at the base of grass clumps. It is gregarious in its habits and may sometimes be found by dozens, especially in the fall, under stones in pastures.

There is also a great variation in the form and continuity of the aperture in this species; about one-third of the specimens collected will be found to have the aperture complete and the opening will appear to be almost rimate. It is often more reflected in some specimens than in others. But the size of the shell and the sculpturing seem to be quite uniform.

LEUCOCHILA CONTRACTA Say. Plate 6, fig. 10.

Shell subconical; epidermis whitish horn-color; whorls between five and six, very convex, diminishing regularly from the last whorl, which is somewhat ventricose, to the apex; suture well impressed; peristome white, thickened, somewhat reflected, its extremities connected by a raised, testaceous fold, making the margin of the aperture entire; aperture lateral, rather triangular or trilobate, more than half as wide as the body whorl, expanded above and diminishing regularly



Fig. 12.

into a very narrow throat, with four teeth, one upon the columella, large, coarse, and irregular, projecting into and very much filling up the aperture, and having a concavity on the side towards the peristome; another tuberculous, not large, more or less near the margin of the peristome; and two others, massive and prominent, deep-seated in the throat, one being in the base behind the columellar tooth and the other on the side of the umbilicus and apparently produced by the umbilical fold; umbilicus with a minute perforation; base of the shell with a sharp keel between the umbilicus and margin; last whorl impressed behind the peristome. (Binney.)

The same remarks apply, in nearly all particulars, as were made above in the case of *Leucochila armifera*. The characters of the denticles are very variable, and besides the fact that they are present there is no apparent order observable in their arrangement. This species ranges all over Indiana and is found in the usual situations of these small forms; I have also taken it in gardens. The short and thick-set character of the shell, which sometimes attains a length of three mm., will readily distinguish it.

LEUCOCHILA CORTICARIA Say. Plate 6, figs. 12, 12a, 12b, 12c.



Fig. 13. Shell whitish, shining, cylindrical, obtuse at the apex; whorls rather more than five, convex; suture well impressed; aperture lateral, two-thirds as wide as the last whorl, sub-orbicular, with a single tooth (sometimes two) on the parietal wall near the center, and a tooth-like enlargement near the umbilical termination of the peristome, which is white, reflected; umbilicus very minutely perforated. (Binney.)

This little shell, which attains the length of two and one-half mm., has a form similar to that of *Leucochila fallax*, but is a much smaller shell and is always white or waxy-white. It is found under sticks, stones, driftwood, and under the bark of fallen trees. It can be easily distinguished by the one or two little white parietal denticles.

This little species was described by Say in Nicholson's Encyclopedia, a work now very rare, and from which I copy the following original description:

"*P. Corticaria*. Shell dextral, cylindrical, obtuse at the apex; whorls five, not perceptibly wrinkled or striate. Aperture suborbicular, lip reflected; a single tooth on the pillar lip near the outer angle; inner angle with an angular projection resembling a second tooth, sometimes obsolete.

"Length about the tenth of an inch."

ISTHIA (VERTIGO) MILIUM Gould.

Shell very minute, subcylindrical, diminishing equally to both extremities; epidermis dark-amber or chestnut color; whorls five, rounded, very minutely striated, decreasing slightly to the apex, which is obtuse; suture deep; peristome white, slightly reflected; aperture lateral, half the width of the last whorl, within brownish, general shape semicircular, truncated abruptly and directly by the last whorl, a testaceous deposit upon which forms the transverse margin and connects the two extremities of the peristome; circumference made up of two curves of different radius uniting in the peristome, where the junction causes an angle projecting inwards, the smaller curve comprising about one-fourth part and forming the superior portion of the peristome; teeth six, two on the transverse margin, sharp, projecting, and tooth-like; one in the angle between the columella and transverse margins, broad, massive, and prominent, with occasionally one or more tubercles about its base; one on the lower part of the columellar margin; two on the peristome, in the base of the aperture, and at the junction of the two curves; umbilicus rather wide. (Binney.)

This little species is found under boards and sticks, bark and stones, in low grounds generally, but also may be taken on hillsides under leaves. Many are often found together. I have seen specimens from Brookville and from Lawrenceburg, and it ought to occur in many localities in the State. It is one of the smallest of our land shells, but the rich and deep mahogany color, shining, will enable its detection. It can not possibly be confounded with any other than the following species, but it is less than a single millimeter in length, while the following form is three millimeters, occasionally more, in length. It is a beautiful object under high magnification.

ISTHIA (VERTIGO) OVATA Say. Plate 6, fig. 13, and plate 7, fig. 1.

Shell minute, ovate-conic, ventricose, dark amber-colored; whorls five, very convex, the last much inflated, diminishing rather rapidly to a somewhat acute apex, with an indentation towards the aperture; suture rather deep; peristome thin, somewhat expanded, with a groove behind and a thickening within; aperture in general outline semicircular, the curve consisting of segments of two different-sized but well-defined circles, the smaller on the right at the junction of the peristome and body-whorl, comprising about one-fourth of the whole contour, and forming an angle at their junction; teeth generally six, two on the transverse margin, two on the columellar margin, the upper of which is massive, the lower pointed, and two on the peri-

stome, in the base and at the junction of the two curves, sharp and prominent; umbilicus expanded. (Binney.)

The dark amber-color which this shell exhibits, when alive, is due to the color of the animal, which is a deep reddish. The shell is mahogany-colored when the animal has been placed in alcohol and allowed to dry up. The species is to be found in swampy areas, along streams, under sticks and flat stones, and seems best to love very wet stations. In meadows which have swampy areas in which *Carex* grows, this shell may be trapped abundantly by placing a few boards near the margins of the wettest places. On turning them over, after a few days, a number of individuals may be taken. The form is gregarious. I have seen it only from Lawrenceburg and Indianapolis, but it doubtless is of wide distribution all over the State. The characters of the denticles are not constant, since many individuals may be found with every possible variation of angle and arrangement. In some specimens the aperture appears to be almost closed by them.

FAMILY STENOGYRIDÆ.

FERUSSACIA SUBCYLINDRICA Linnæus. Plate 4, fig. 8.

Shell small, thin, transparent, oblong-oval; epidermis smoky horn-color, smooth, very bright and shining; whorls five or six, somewhat rounded, the last equaling two-fifths the shell's length, rounded at the base; apex obtuse; suture somewhat impressed; aperture lateral, oval, its plane nearly parallel with the axis of the shell; peristome simple, thickened, often slightly rufous; umbilicus imperforate; columella obsoletely truncated at base. (Binney.)

This beautiful and glossy shell is circumpolar in its distribution and is the sole representative of its genus in America. It occurs quite commonly over the northern parts of Indiana, on hillsides, under leaves and sticks and stones, and in forests under bark, between the bark and the wood of fallen trees. Its epidermis is the most brilliant of any form in the State. I have never seen an example from the southern portions of the State, but there is no reason why it should not occur there. It attains a length of about five and one-half mm.

FAMILY SUCCINIDÆ.

SUCCINEA OVALIS Gould. Plate 7, fig. 4.

Shell ovate, somewhat conic, very thin, pellucid, watery horn-color, sometimes tinted roseate; periostraca shining, very minutely striate; whorls three, the last compressed and elongate when viewed above;

spire short but acute; suture impressed; aperture produced by a deep truncation of the shell, elongated more than three-fourths the length of the shell, patulous, expanding anteriorly, exhibiting the interior of the volutions; when viewed on the side of the aperture the conical shape of the shell appears; the broadest part of the cone is below the center of the aperture and it tapers gradually to the apex. (Binney.)

This species occurs over all the State, and is especially common among the reeds on the margins of the lakes in the northern portions of the State. It hides in great numbers at the foot of *Carex* clumps, in swampy areas, and may often be taken on the stems and leaves of plants which grow near the water. Its shape is unlike that of any other species in the State, and it is easily distinguished thereby. The epidermis is often darker colored than Binney's description would indicate. The shell has been noticed in nearly all piles of river drift, indicating that its habitats may be the low and swampy areas of river bottoms. I have collected a number of specimens clinging to the lower surfaces of "wild sunflowers"—*Helianthus*.

SUCCINEA AVARA Say. Plate 7, fig. 3.

Shell rather small, thin and fragile, straw-colored, rosy, amber-colored, or greenish; periostraca shining, or presenting minute hairy processes in the young; whorls three, very convex, separated by a deep suture; last whorl rather large, not much expanded; spire very prominent, acute; aperture ovate, rounded at both extremities, about half as long as the shell. Extreme length, about six mm. (Binney.)

This is the smallest form of *Succinea* in the State, and is found in a variety of situations, under sticks, stones, on trees, under logs, in wet and in dry stations, in lowlands and on hillsides. In fact, nearly every station will yield specimens of this shell. Its whorls are more conspicuously rounded than any other form. It has been seen from New Albany, Madison, Bloomington, Indianapolis, Lawrenceburg, North Manchester, Brookville and Wabash. It delights to secrete itself under wet logs, in river bottoms, in sandy stations, and I have frequently so found it. The animal is darker in coloration than the other Indiana species.

SUCCINEA OBLIQUA Say. Plate 7, fig. 2.

Shell ovate, pale green, yellowish-green, amber-colored, or cinereous, very thin and fragile, pellucid, sometimes roseate at apex; periostraca shining, minutely wrinkled or striated; whorls rather more than three, the last very large and much expanded and more or less oblique; spire very small, not prominent nor pointed; suture distinct,

impressed; aperture oval, large, and expanded, more or less oblique; columellar margin with a slight testaceous glazing; columella thin, sharp, narrow; peristome thin, its edge blunted by the reflection of the periostraca. Greatest length, 25 mm.; ordinary length, 18 mm. (Binney.)

This species is the largest of the Indiana forms and is found in open fields, under sticks, planks, and stones, on the banks of rivers, under the bark which has fallen from half-rotted trees, on the stems of aquatic plants, and under the leaves of the swamp alder. I have found hundreds of specimens in a swampy location, on reeds and stems of plants, after a rain, the animals having been evidently driven from the ground to these places for safety. They are found on the margins of swamps, at times, but commonly love best those stations which are more dry. None of the species are amphibious, as is commonly supposed.

A form which Dr. Lea called *Succinea totteniana* is sometimes noticed in collections and may always be seen in the exchange lists of tyros who desire to get "full collections" without being particular in the matter of synonymy; this form is synonymous with Say's older species.

The habits of the *Succineæ* are interesting. They are unable, especially during the nidification season, to withdraw themselves wholly within their shells, and some considerable portion of the animal appears protruding beyond the apertural margin. While they do not ever retract themselves very far within the shells, it is common to find them, in dry weather, so far within the shells that over half of the body-whorl is empty; this is the usual condition when they go into hibernation. They are often found adhering, in dry weather, to leaves and plant stems, with a tenacious epiphragm which holds them in place and which entirely covers the aperture. The animals are commonly some shade of light yellow, with occasional darker blotches, and the heads are often the darkest portion of the body. The tentacles are rather large and thick, club-shaped, and are often the home of a stage in the development of a planarian.

To facilitate the systematic study of these interesting forms, there is added below a classified table of the species thus far known in Indiana. It is by no means a fact that all the varieties to be found in the State have yet come to light, but such additional forms as may from time to time be discovered are likely to fall within the arrangement of forms as exhibited in this table. The reader will note that seven families, fourteen genera, and eight subgenera are represented, by a total of fifty species. The variety is not great, when one con-

siders the favorable characters of Indiana forests and plains, but the paucity of groups is compensated by the great numbers of individuals, some forms of which find here their metropolis.

PULMONATA GEOPHILA.

FAMILY.	GENUS.	SUBGENUS.	SPECIES.
Selenitidæ	Macrocyclus		concaua.
Limacidæ	Limax		flavus.
	Zonites	Mesomphix	campestris.
			fuliginosus.
			friabilis.
			ligerus.
			intertextus.
			inornatus.
		Hyalinia	arbores.
			limatulus.
		Conulus	fulvus.
		Gastrodonta	internus.
Philomycidæ	Tebennophorus		carolinensis.
Helicidæ	Patula		dorsalis.
			solitaria.
			alternata.
			perspectiva.
			striatella.
	Helicodiscus		lineatus.
	Strobila	Stenotrema	labyrinthica.
			stenotremum.
			hirsutum.
			monodon.
			palliat.
			obstricta.
			appressa.
			indecta.
			tridentata.
			fallax.
			albibris.
			multilineatus.
			pennsylvanicus.
			mitchellianus.
			elevatus.
			exoletus.
			thyroideus.
			clausus.
			profundus.
			pulchella.
Pupidæ	Vallonia		pentodon.
	Pupa	Pupilla	fallax.
		Leucochila	armi era.
			contracta.
			corticaria.
			millium.
		Isthmia	ovata.
Stenogyridæ	Ferussacia		subcylindrica.
Succinidæ	Succinea		ovalis.
			avara.
			obliqua.

PULMONATA LIMNOPHILA.

ARTIFICIAL KEY TO THE LIMNÆIDÆ.

- | | |
|---|-----------------------|
| A. Shell elongate, dextral. | <i>Linnophyca.</i> |
| B. Shell ovate, sinistral or reversed. | <i>Physa.</i> |
| C. Shell large, discoidal, umbilicated. | <i>Helisoma, etc.</i> |
| D. Shell small, discoidal, flat, aperture simple, decurved, carinate. | <i>Menetus.</i> |
| E. Shell small, discoidal, ecarinate. | <i>Gyraulus.</i> |
| F. Shell minute, white, elongate. | <i>Carychium.*</i> |

LIMNOPHILA.

SUBFAMILY AURICULINÆ.

CARYCHIUM.

CARYCHIUM EXIGUUM Say.

Shell minute, elongated, tapering at both ends, white, translucent, shining; apex rather obtuse; whorls five to six, convex, very oblique, with transverse striae; suture distinct, impressed; aperture obliquely oval, white, with a prominent plait on the columellar margin, about midway between the extremities of the lip, and a slightly prominent fold near the junction of the lip with the umbilical extremity of the shell; lip thick, reflected, flattened; umbilicus perforated.

Length one and three-fifths mm., diameter three-fourths mm. Aperture one-half mm. long.

This is one of the most minute of American shells; it is common in many localities in Indiana, but must be sought for near the water or in permanently moist stations. I have taken it at Lawrenceburg, Indianapolis and New Albany; there are records of occurrence in many other localities. The form is thought by many to be a land shell, but it is not; it may be found on the under side of submerged boards on the borders of ponds and swamps, a station which a land shell could never endure. The margins of damp woods, under the leaves and close to the wet earth will usually disclose this little shell.

*This little shell is not a limnæid though belonging to the *Limnophila*; it is one of the *Auriculidæ* and is placed here for convenience merely.

FAMILY LIMNÆIDÆ.

SUBGENUS LIMNOPHYSA.

LIMNOPHYSA REFLEXA Say. Plate 8, fig. 8.

"Shell fragile, very much elongated, narrow, honey-yellow, tintured with brownish, translucent, slightly reflected from the middle; volutions six, oblique, wrinkled transversely; spire more than one and a half times the length of the aperture, acute, two or three terminal whorls vitreous, body-whorl very much dilated; aperture rather narrow; labrum with a pale margin, and dusky red or blackish submargin." (Say.)

This limnæid is common in northern Indiana and occurs in all the lakes and swamp-streams as well as ponds. It is exceedingly variable; often specimens are found which far exceed the dimensions given by Say in his original description quoted above. The form belongs to the sub-boreal fauna; the distribution in America is very wide over all the middle portions of the continent. The whorls are sometimes very ventricose, the spire shortened and stubby, the aperture dilated, and often purplish-colored within. A form was described by Tryon as *Limnæa zebra*, but it is only a local variety of this species. The most southerly point at which I have observed it in this State is Terre Haute.

LIMNOPHYSA PALUSTRIS Müller. Plate 8, fig. 5.

"Shell oblong-conic, gradually acuminate, reticulate with transverse lines and longitudinal wrinkles; whorls rather more than six; spire acutely terminated; suture moderately impressed; aperture shorter than the spire; labrum, inner submargin, reddish obscure; labium, calcareous deposit rather copious, not appressed at base, but leaving a linear umbilical aperture; body-whorl on the back longer than the spire." (Say.)

This shell is often confounded with the preceding, and indeed it does closely resemble it; however, this form is more ventricose than *reflexa* ever becomes, and the peculiarly malleated character of the body-whorl will help to separate them. Its habits are about the same as those of the preceding shell; it is, however, a more abundant shell and is confined more closely to swamps and swales. The apical whorls are often denuded of epidermis and then eroding give to the shell a very rough appearance. Specimens have been seen from Tippecanoe and Turkey lakes, from the St. Mary's River, and from swamps near

Marion, where the species is very abundant. This shell has a rather lighter colored epidermis than *reflexa*, and is rarely so purple within the aperture; it is, on the whole, a little more fragile.

LIMNOPHYSA DESIDIOSA Say. Plate 8, fig. 6.

"Shell oblong-subconic; whorls five, very convex, the fourth and fifth very small, the second rather large, suture deeply indented; aperture equal to or rather longer than the spire; labium, calcareous deposit copious, not perfectly appressed at base, but leaving a very small umbilical aperture. * * * Length seven-tenths of an inch." (Say.)

This is one of the smallest of the limnæids and is at the same time one of the most abundant; it occurs all over the State and in every variety of station; it especially should be sought on gently sloping muddy banks along the Wabash, the Ohio, or the Kankakee. I have seen examples from over twenty different localities in Indiana. The epidermis is exceedingly thin and light-colored, the aperture is rather large and the animal quite black; the whorls seem to be very loosely coiled. Water-fowl destroy thousands of these little animals, their habit of crawling on the bottom near the water's edge and in shallow places rendering them easy of access. In wet and marshy places along the Wabash it may often be taken by thousands, and in the small pools left by retreating floods many thousands are always stranded, only to die or become the food of wading birds.

LIMNOPHYSA CAPERATA Say. Plate 8, fig. 7.

"Shell suboval, a little oblong, obscurely yellowish horn-color; spire half the length of the mouth; apex acute; whorls slightly wrinkled across, and with very numerous, equal, subequidistant, elevated, minute, revolving lines; suture not very deeply impressed; aperture rather dilated; fold of the labium not profound. Inhabits Indiana." (Say.)

This is another exceedingly abundant shell in Indiana, from which State the original specimens came. It inhabits swamps, ponds, creeks, and rivers, among rushes and weeds; it is often distorted, like all others of this group, from living in close quarters in reedy swamps. The epidermis is generally reddish horn-color and is much darker than Say's description would seem to warrant. This fact, added to the fact that the aperture is often reddish or purplish within, has resulted in this shell being often found with collections of *Limnophysa reflexa*, which it somewhat resembles; especially does it resemble the half-grown form. But this species is quite a solid shell, heavier in texture

than any other found in the State, and is often quite highly polished; the reticulated character of the epidermis of the body-whorl will help to separate it. I have found it at North Vernon, Madison, Lawrenceburg, Portland, Marion, and Wabash. It will be found all over the State.

LIMNOPHYSA HUMILIS Say. Plate 8, fig. 9.

"Shell ovate-conic, thin, translucent, with slight wrinkles; volutions nearly six, convex, terminal one very minute; suture well indented; aperture about equal in length to the spire; labium with an obvious plate of calcareous deposit; a distinct and rather open umbilical aperture; color pale reddish-white or yellowish-white. Total length seven-twentieths inch." (Say.)

This little shell was described from South Carolina, but is found all over the eastern United States, from Colorado and Wyoming to Georgia. In this State it is not only common but is abundant. In 1893 the writer found the sloping bank of the Ohio, on the Indiana side, near New Albany, where for a half mile or more numerous springs keep the muddy banks and shales wet, and where an abundant marshy vegetation grows, covered by hundreds of thousands of this shell. They were literally everywhere! As they crawled about in the wet mud they made the peculiar snapping noise so familiar to collectors of these forms. They were not in the water but crawling about on the very soft and wet mud. The shell is easily told from *Limnophysa desidiosa*, which it most nearly resembles, by the small and regular spire, the whorls being closely coiled together and the spire being far more regular. I have also taken it at Lawrenceburg, at Terre Haute, at Wabash and at Fort Wayne, in the Maumee River. It will be found in every part of the State on careful search.

GENUS PHYSA.

PHYSA GYRINA Say. Plate 8, fig. 1.

"Shell heterostrophe, oblong; whorls five or six, gradually acuminate to an acute apex; suture slightly impressed; aperture more than one-half, but less than two-thirds, the length of the shell; labrum a little thickened on the inner margin. Length rather less than one inch." (Say.)

Almost every stream in the State exhibits numbers of this species. It is a brown or reddish-brown shell, with a peculiarly margined aperture; it is, also, when mature, a rather solid shell. From the next species it differs in the form of the spire, being rather more acuminate, though numerous examples may be found which are

blunter; such were described by Dr. Lea under the name of *Physa hildrethiana*. The largest and finest examples from this State come from the lakes and ponds of northern Indiana, and from the Kankakee. In immature specimens the labrum is hardly thickened and the calcareous deposit on the columella is scarcely evident; but in old shells these are well marked. Numerous parallel lines of growth sometimes give the body-whorl a roughened appearance. It may almost always be found on muddy banks of rivers near the edge in the water, rapidly moving along. In walking, the animal has a peculiar gliding motion that takes it over a great amount of ground in a very short time; this form and its relatives are the most rapid travelers among the fresh-water shells. The fringed character of the mantle should also be noticed by the collector, for none but these forms present that character.

PHYSA ANCILLARIA Say. Plate 8, fig. 4.

"Shell heterostrophe, subglobose, pale yellowish; whorls rather more than four, very rapidly attenuated; spire truncated, hardly elevated beyond the general curve of the surface; suture not impressed; aperture but little shorter than the shell, dilated; labrum a little thickened on the inner margin. Length more than one-half of an inch." (Say.)

The only locality from which specimens have been seen in Indiana is Turkey Lake; four specimens were collected by the Indiana University Biological Station. The ordinary color of the shell is light honey-yellow, polished very highly; in the Turkey Lake specimens the epidermis is a milky white, is highly polished, but very thin. The very short spire, with the acuminate apex, the shouldered body-whorl, and the waved outline of the calcareous deposit on the body-whorl at the aperture will serve to distinguish it from the two remaining Indiana forms. The species will probably be found in many of the lakes and ponds of the northern part of the State.

PHYSA HETEROSTROPHA Say. Plate 8, fig. 3.

"Shell sinistral, subovated; color pale yellow, chestnut or blackish; whorls four, the first large, the others very small, terminating rather abruptly in an acute apex; aperture large, somewhat oval, three-fourths of the length of the shell, or rather more; within of a pearly lustre, often blackish; lip a little thickened on the inside, and tinged with dull red." (Say.)

This is the most widely distributed and most variable limnæid in America; it ranges from New England to Great Slave Lake, to Wash-

ington, to Texas and Georgia. In Indiana it is found everywhere; in all streams, both large and small, in ponds, lakes, pools, ditches. An extensive synonymy has been built up on this form through failure to recognize its excessive variability. It is colored like *Physa gyrina*, has the same general habits, but is more pointed and the spire is generally less conical. I found this shell very abundant in the old canal at Brookville, and in a small stream near Madison. In the Ohio, Wabash and Maumee the shells are larger and thicker than those from the lakes.

GENUS BULINUS.

BULINUS HYPNORUM Linnæus. Plate 8, fig. 2.

"Shell heterostrophe, pale yellowish, very fragile, diaphanous, oblong, whorls six or seven; spire tapering, acute at the tip; suture slightly impressed; aperture not dilated, attenuated above, about half as long as the shell; columella much narrowed near the base, so that the view may be partially extended from the base towards the apex.

"Inhabits shores of Illinois. Length seven-tenths inch; greatest breadth three-tenths nearly. Animal deep black, immaculate above and beneath; tentacula setaceous; a white annulation at base." (Say.)

This is a very highly polished form and may be distinguished by its narrow outline, acute spire, and the number of whorls; it occurs in many localities in the State. At Indianapolis, Coffee Chute, Gibson County, and in the small lakes of northern Indiana it has been taken. Usually the shell does not exceed one-half inch in length; mature specimens are rather solid than fragile. While it is sinistral, like *Physa*, its narrow aperture and long pointed spire differ entirely from any form of that genus in Indiana.

SUBGENUS PLANORBELLA.

PLANORBELLA CAMPANULATA Say. Plate 8, fig. 12.

"Shell sinistral, not depressed; whorls four, slightly striate across; longer than wide; spire hardly concave, often plane; body-whorl abruptly dilated near the aperture and not longer behind the dilatation than the penultimate whorl; suture indented, well defined to the tip, the summits of the volutions being rounded; aperture dilated; throat narrow abruptly; umbilicus profound, the view extending by a minute foramen to the apex. Greatest length of the body-whorl one-fourth of an inch; breadth from tip of the labrum one-half of an inch; at right angles to the last, two-fifths of an inch." (Say.)

Widely and commonly distributed over nearly all of the State. Distinguished by the narrow constriction behind the aperture, and

the bell-shaped character of the aperture, from which the specific name is derived. While the epidermis is usually light horn-color, specimens are often taken which are perfectly albino and highly polished. Occasionally specimens are to be had which are coarsely wrinkled, but the species is commonly smooth.

SUBGENUS HELISOMA.

HELISOMA TRIVOLVIS Say. Plate 8, fig. 11.

"Shell sinistral, pale yellow, brownish or chestnut color, subcarinate above and beneath, particularly in the young shell; whorls three or four, striate across with fine, raised, equidistant, acute lines, forming grooves between them; spire concave; aperture large, embracing a considerable portion of the body-whorl, within bluish-white; lip a little thickened internally, and of a red or brownish color, vaulted above; umbilicus large, exhibiting the volutions. Length one-fourth of an inch; breadth one-half of an inch. Animal aquatic, dark ferruginous, with very numerous, confluent, pale yellowish points; tentacula long, setaceous, with confluent points; foramen on the left side." (Say.)

This shell is common all over Indiana and is especially abundant, as indeed are most of the limnæids, in the lake region of the northern half of the State. It is the largest of the discoidal forms and can not be confounded with any other. I have personally observed it at New Albany, Bloomington, Evansville, Terre Haute, Lawrenceburg, Brookville, North Manchester, Fort Wayne, Huntington, and Winona Park. Among the reeds of the smaller lakes it is exceedingly abundant.

HELISOMA BICARINATA Say. Plate 8, fig. 10.

"Shell sinistral, pale yellow or brownish, subcarinate above, and beneath translucent. Spire retus-umbilicate, forming a cavity as deep as that of the base. Aperture large, embracing a considerable portion of the body-whorl, and much vaulted above. Within red brown, with two white lines corresponding with the carina. Whorls three, wrinkled and with minute revolving lines. Length one-fourth of an inch; breadth nearly half an inch." (Say.)

This widely distributed shell is characterized by the two rounded carinæ, one on either side of the discoidal shell; it is much smaller than any other of the subgenus and need not be confused with any except the young of *Helisoma trivolvis*; but the unfailing signs of juvenility should enable ready recognition. This form is thickened near the margin of the aperture, while half-grown *trivolvis* is very thin

and fragile all about the labrum. This shell is smoother than *trivolvis* and the outline of the aperture is angular.

SUBGENUS MENETUS.

MENETUS EXACUTUS Say. Plate 8, fig. 24.

"Shell dextral, depressed, with an acute edge; whorls four, striated across, wider than long, not elevated above the suture, but a little flattened, sides obliquely descending to an acute edge below the middle; spire not impressed; suture not profoundly indented; beneath, body-whorl flattened, on the inner edge rounded; umbilicus regular, exhibiting all the volutions to the apex; aperture transversely subtriangular; labrum angulated in the middle, arcuated near its inferior tip, the superior termination just including the acute edge of the penultimate whorl. Greatest breadth rather less than one-fourth of an inch." (Say.)

This little shell may be found on the under side of lily-pads in lakes and ponds; on sticks and stones along the margins of ponds just under the water. It is impossible to confuse it with any other shell, the very sharp carina alone distinguishing it from all others. It is commonly black or very dark horn-color; the animal being itself black and the shell being rather thin, this makes the whole a very black object against the bright green of the lily-pads. I have seen specimens from near Lawrenceburg and have taken the form at Fort Wayne. It is probably widely distributed in the State.

SUBGENUS GYRAULUS.

GYRAULUS DEFLECTUS Say. Plate 8, fig. 13.

"Shell dextral, depressed; whorls nearly five, minutely and regularly wrinkled across, wider than long, with a much depressed rotundity above, descending to an acute lateral edge below the middle; spire not impressed; suture indented, but not profoundly; beneath a little concave in the middle, exhibiting one-half of each volution to the apex; whorls flattened, slightly rounded; aperture declining very much, suboval, the superior portion of the labrum considerably surpassing the inferior portion, and taking its origin a little above the carina; inferior portion of the labrum terminating on the middle of the inferior surface of the penultimate whorl. Greatest breadth two-fifths of an inch." (Say.)

This shell has been seen by me in only one locality on lily-pads in a yard at Lawrenceburg, adjoining my home. It may have been introduced with the plants; but it naturally belongs to the western fauna and should be in this State. I have therefore included it. The

shell is smaller than any other of its group except the following; from it separation may readily be made by the deflected aperture, which feature is presented by no other shell. The shell is black and the animal likewise. Lily-pads in northern lakes should be carefully searched for this shell, which will surely occur there.

GYRAULUS PARVUS Say. Plate 8, fig. 14.

"Shell horn-color or blackish; whorls four, crossed by minute wrinkles; concave above and beneath, and equally exhibiting the volutions, body generally subcarinate on the margin; lip rounded, and not vaulted above nor thickened; mouth within bluish-white. Breadth one-fifth of an inch." (Say.)

This very short description of Say might be supplemented by the statement that the body-whorl regularly and symmetrically increases in breadth, the wrinkles which cross the body-whorl are caused by the regularly placed lines of growth, the shell has a brightly polished epidermis and the aperture is regularly and ovately rounded. The species is common all over Indiana; it is found in the same stations as the last described shell, but is only about half as large and is not at all deflected in the region of the aperture. Near Moore's Hill, in Dearborn County, is a small pond which has many hundreds of these shells attached to the stems of pond weeds. It has been observed, also, at Madison and Terre Haute. It will certainly be found in all parts of the State.

SUBFAMILY ANCYLINÆ.

GENUS ANCYLUS.

ANCYLUS TARDUS Say. Plate 8, fig. 15.

"Shell conic depressed; apex behind the middle, obtuse, rounded, inclining backward but not laterally; line from the apex to the posterior tip rectilinear; line from the apex to the anterior tip arcuated; aperture oval, not distinctly narrowed at one end. Length a little over three-twentieths, breadth one-tenth of an inch. * * * It inhabits the Wabash River." (Say.)

This little shell is very common in the Wabash, the Ohio and the Maumee rivers; it no doubt occurs in many other streams. Its limpet-like shape, though exceedingly small, will enable it to be easily detected. It should be looked for on the inside of dead *Unio* valves, and a half dozen sometimes may be taken from the same shell. A favorite place for these shells to be attached are the forms of *Pleurocera* and occasionally of *Campeloma*, but sticks, stones and submerged

boards will also yield them. There are certainly other species in the streams of Indiana, and they should be carefully searched. The inside of the shell, after removal of the animal, is often a dark brown or sometimes slightly purplish color. The striations of the epidermis show through as fine capillary lines and are concentrically placed.

RISSOIDÆ.

This is a rather large family of very small shells, and is represented in Indiana waters by only two subfamilies, the *Hydrobiinæ* and the *Pomatiopsinæ*, the latter of which is amphibious. Four genera are represented in Indiana waters, as follows: *Amnicola*, *Bythinella*, *Somatogyrus* and *Pomatiopsis*.

These little mollusks are to be sought for on muddy bottoms associated with the large *Viviparidæ*; the stations which are suited to the one agree with the habits of the other. All are rather minute shells, the largest forms being *Somatogyrus*, of which two species are known in Indiana.

KEY TO THE RISSOIDÆ.

- | | |
|---|----------------------|
| A. Shell rimate, pupiform, imperforate, obtuse. | <i>Bythinella</i> . |
| B. Shell globose, perforate, rather large. | <i>Somatogyrus</i> . |
| C. Shell small, ovate, perforate, short. | <i>Amnicola</i> . |
| D. Shell long, subumbilicate, thin, amphibious. | <i>Pomatiopsis</i> . |

With the exception of the last-named genus, all are fresh-water shells; but *Pomatiopsis* may be found in damp places, and, indeed, in places quite dry. Near Cincinnati, Ohio, along the Little Miami, this shell is abundant in a dry glade, but must be sought under leaves and rushes close to the ground. All the others are found in running streams and are commonly abundant; dredging for them with fine-meshed nets usually secures very many, though specimens may be taken which are crawling on the mud near the water's edge, but wholly submerged.

GENUS BYTHINELLA.

BYTHINELLA OBTUSA Lea. Plate 8, fig. 18.

"Shell subcylindrical, rather thin, dark-green, smooth, slightly perforate; spire short; at the beaks very obtuse; sutures impressed; whorls four, convex; aperture small, nearly round." (Lea.)

This little shell may be readily distinguished by the very blunt character of the apex; the whorls are also very convex and the aperture is rimate. A large number of specimens were once collected by the

writer in the Des Moines River; from them it was learned that in clean specimens the epidermis is almost white. The dark color is due to iron oxide, with which most of the shells are discolored.

Specimens have been seen only from the Ohio, but in that stream it is common. The dredge should be employed if it is desired to collect very many; then a free scraping of muddy banks will reveal multitudes of shells of this species.

GENUS SOMATOGYRUS.

SOMATOGYRUS ISOGONUS Say. Plate 8, fig. 20.

"Subglobose, horn-color, volutions about four, rounded, obsoletely wrinkled; spire very short, about one-third the length of the aperture; suture profoundly impressed, so as to form a shoulder on the whorls; aperture much dilated, oval, being as obtusely rounded above as at base; umbilicus linear, distinct; operculum obviously spiral. Length under three-tenths of an inch." (Lea.)

This little shell is exceedingly abundant on the Falls of the Ohio at Louisville; rare specimens have been taken at Lawrenceburg, also in the Ohio. It is a regularly rounded form, and delights along the margins of the river, crawling in the soft mud. It is often half hidden in the mud, in this respect resembling the large *Campeloma*. From the following shell it may be distinguished by the round and full aperture, the next form having an angular one. This one is also very much smaller; the volutions are about the same in number, but those of *isogonus* increase less rapidly. Both shells are operculated.

SOMATOGYRUS INTEGER Say. Plate 8, fig. 19.

"Subglobose, horn-color; volutions rather more than three, rounded, obsoletely wrinkled; spire very short, less than half the length of the aperture; suture rather deeply impressed; body whorl large, aperture dilated, ovate, acute above; columella flattened, polished; labrum regularly rounded; base regularly rounded, without any undulations or sinus; umbilicus none; operculum obviously spiral. Length nearly one-fifth of an inch. Animal, foot longer than wide, rounded behind, with the anterior angles a little excurved; eyes black, conspicuous; tentacula rather long and slender." (Say.)

This shell was originally described from the Ohio River and said to be very abundant at the Falls by Say. In association with *Campeloma* I have found it abundantly at Lawrenceburg and at Charleston, both in the Ohio. It is a much larger and coarser shell than the preceding.

GENUS AMNICOLA.

AMNICOLA PORATA Say. Plate 8, fig. 21.

"Shell obtusely conic or subglobose; volutions four, convex, obsoletely wrinkled across; spire obtuse; labrum and labium equally rounded, meeting above in a subacute angle; the upper edge of the latter appressed to the preceding whorl; umbilicus very distinct." (Say.)

This little shell was originally described from Cayuga Lake, New York, but is one of very wide distribution. It has been mistaken for the very young of some larger forms, like *Campeloma*, but has all the marks of maturity when carefully examined. Little need be said about it; all the forms of this section are minute and very hard to determine, and the group needs revision very greatly.

AMNICOLA LIMOSA Say. Plate 8, fig. 23.

"Shell conic, subumbilicate, dark horn-colored, generally incrustated with a blackish irregular covering on the spire, and sometimes on the body, which completely obscures the obsoletely wrinkled epidermis; aperture ovate-orbicular; suture impressed.

"Length, three-twentieths; breadth, one-tenth of an inch." (Say.)

This little shell is very like the preceding, but differs in being less well umbilicated. It is found in the same situations, and only careful study can separate them.

AMNICOLA CINCINNATIENSIS Anthony. Plate 8, fig. 22.

"Shell somewhat ventricose, subumbilicate, color delicately green, whorls four, smooth; spire entire at the apex and prominent; suture deeply impressed; aperture much dilated, approaching to orbicular, nearly half the length of the shell; length one-fifth of an inch.

"Found in the canal at Cincinnati, clinging to small stones." (Anthony.)

Undoubted examples of this shell have been found at Lawrenceburg, in the Ohio. It is longer and more acute than any other form of *Amnicola*, and is more brightly green in color. Differences which it exhibits may be best seen by close comparison with the other forms. It is the largest Amnicolid in Indiana.

GENUS POMATIOPSIS.

POMATIOPSIS LAPIDARIA Say. Plate 8, fig. 16.

"Shell turreted, subumbilicate, with six volutions, which are obsoletely wrinkled across. Suture impressed. Aperture longitudinally

ovate-orbicular, operculated, rather more than one-third of the length of the shell. Length about one-fifth of an inch. * * *” (Say.)

Attention has above been directed to the peculiar habits of this species, which is common in parts of this State. It occurs sparingly near Lawrenceburg, but is abundant in the lower Wabash Valley. It is easily told by its length, the rounded character of the whorls, its peculiarly long rostrum, and its very large verge. Being found so commonly in rather dry stations also will serve to show its character as not being an *Amnicola*, the only form with which it could be confused.

FAMILY VALVATIDÆ.

GENUS VALVATA.

VALVATA TRICARINATA Say. Plate 8, fig. 17.

“Shell with three volutions; three revolving, carinate, prominent lines, giving to the whorls a quadrate instead of a cylindric appearance. Suture canaliculate, in consequence of the whorls revolving below the second carina and leaving an interval. Spire convex, apex obtuse. Umbilicus large. Carinæ placed, one on the upper edge of the whorl, one on the lower edge, and the third on the base beneath. Breadth, one-fifth of an inch.” (Say.)

So far as I know this is the only form of *Valvata* in the State; specimens have been taken at Lawrenceburg, in the Ohio, at Fort Wayne in the St. Mary's, and a single dead specimen has been seen from Tippecanoe Lake.

This shell is small, but easily known from all others by its pronounced carinæ and its generally irregular shape. It is usually much more elevated than the figure given herein would indicate, and the space between the carinæ is often hollowed out. The color is light green. The habits of the animal are much like those of the *Rissoidæ*, since it lives on muddy banks and is usually associated with *Amnicola* and other rissoids. The respiratory apparatus is, however, entirely distinct, this form breathing by means of a plumose gill which is projected over the head in moving about.

FAMILY VIVIPARIDÆ.

The shells of this family are all operculated, large, and live in muddy situations in rivers, lakes and ponds. Favorable sites are the ponds left by retreating waters along large rivers like the Wabash; in

such places they may be collected by thousands. There are three genera represented in Indiana waters to which the following artificial key may serve as an introduction:

- A. Shell large, thick, green, aperture elongate, operculum with polar point nearer one end. *Campeloma.*
- B. Shell large, thin, operculum nearly round, shell banded or otherwise highly colored. *Vivipara.*
- C. Shell medium, thin, light green or whitish, with spiral whorls carinated, operculum subspiral. *Lioplax.*

GENUS VIVIPARA.

VIVIPARA SUBPURPUREA Say. Plate 9, figs. 10, 11.

Shell large, thin, thicker towards the apex and in age, globose conical, subumbilicated, smooth, polished; whorls regularly increasing, five in number counting the minute apical whorls, convex, the body whorl marked with transverse lines of growth; epidermis coffee brown or purplish, the apex always reddish purple; suture deep and regularly impressed, in some specimens excavated; peristome simple, ovately rounded, angular above, rounded below; columella white, rather thick; parietal wall with a rather thickish deposit of white calcareous matter which connects the extremities of the aperture and is inclined to be reflected over the region of the umbilicus; in old and mature specimens the body whorl is flattened near the suture, which makes the middle of the whorl to appear to be slightly angular; within chocolate color or purple.

Length, one to one and one-half inches.

This shell occurs only in the Wabash River in this State so far as my information goes; it was described by Say from "Fox River, an arm of the Wabash." In the Mississippi River at Rock Island it is very abundant and has the habit of clinging in numbers to the under sides of large flat stones, in rapidly running water. In the Wabash it appears to live mainly in muddy bottoms, having the habit of *Campeloma*.

VIVIPARA CONTECTOIDES Binney. Plate 9, figs. 13, 13a.

Shell large, globose, thin, umbilicated, spire conically elevated; whorls very convex, flattened near the sutures, five in number, regularly and symmetrically increasing in size; epidermis light yellowish horn-color with three to four brownish-red broad bands revolving with the body whorl, one on the periphery, thin; lines of growth coarse and giving to the shell a transversely striated appearance which, near the margin of the aperture become rather coarse wrinkles; sutures

very deeply impressed; aperture large, roundly ovate, subangular at juncture with body whorl, nearly complete, only a small portion being appressed to the parietal wall, simple, slightly reflected near the umbilicus in old specimens; within bluish white, the brownish color bands showing; columella thin, white, twisted.

Length, one and one-half to two inches for large and mature specimens.

Very abundant in the ponds along the Wabash and in the muddy streams of the northwestern parts of the State. In the Wabash itself the shell is extremely common from Lafayette down to its mouth. Many specimens are malleated on the body whorl, but not all are so. A few specimens have been seen from Lake Maxinkuckee, but it thrives best in ponds along rivers and in rivers. The color bands enable one to distinguish it from all others.

VIVIPARA INTERTEXTA Say. Plate 9, fig. 12.

"Shell subglobose, yellowish-green or brownish, wrinkled, and with minute, very numerous, obsolete revolving, deciduous lines; spire depressed conic, obtuse, truncated, eroded at tip; volutions nearly four; suture rather deeply indented; umbilicus closed by the lateral extension of the columella.

Greatest breadth, from four-fifths to one inch; length, about the same. * * *" (Say.)

No specimens were at hand from which to make a new description, which is greatly needed, and I therefore copy the original description of Say. As known in Indiana, from the Wabash River and from Lake Maxinkuckee, the color given by Say is not that of Indiana specimens; they are all of a rich and deep reddish or wine color; the epidermis is highly polished and altogether the shell is a beautiful one. From the ponds along the Wabash, near Mt. Carmel, Illinois, I have seen very large and fine examples; but the shell is really a southern form, reaching its greatest development both of size and in numbers in Mississippi and Louisiana.

GENUS LIOPLAX.

LIOPLAX SUBCABINATA Say. Plate 9, figs. 14, 14a, 15.

Shell rather small, elevated, spire regularly conical, operculated, obtusely carinated, especially on the spiral whorls; epidermis yellowish-white, thin, white at apex, occasionally light green, whorls five and one-half, regularly increasing, carinate, convex, flattened at the sutures; suture irregularly impressed, sometimes hollowed out; body whorl large, ventricose, with two coarse carinae near the upper angle of the aperture, but which



Fig. A.

are not continuous across the whole whorl; aperture ovate, rounded below and slightly angulate above, sigmoid; peritreme simple, continuous over the parietal wall as a thin callus; operculum thin, light corneous.

Length, three-fourths of an inch.

This shell occurs in the White, Wabash, Ohio and Blue rivers. It is commonly associated with *Campeloma* and *Vivipara*, and has the same habits. The carinæ on the apical whorls and the subspiral aperture will alone separate it from all other viviparids in the State. It is common in the Ohio at all points.

GENUS CAMPELOMA.

CAMPELOMA PONDEROSUM Say. Plate 10, figs. 4, 5, 6.

Paludina ponderosa, Say. Jour. Acad. Nat. Sci., Phil., Vol. II, p. 173 (1821); American Conchology, Pt. III, Pl. XXX, fig. 1 (1830).—Haldeman in "Monograph of the Fresh-Water Univalve Mollusca of the U. S.," No. 1, p. 13, Pl. IV (1840).

Paludina regularis, Lea. Trans. Am. Phil. Soc., Vol. IX, p. 13 (1844). This is the young of *ponderosum*.

Melantho ponderosa, Say. Binney in "Land and Fresh-Water Shells of N. A.," Pt. III, pp. 36-40, figs. 71-78 (1865).

Vivipara (Melantho) ponderosa, Say. Tryon. Continuation of Haldeman, p. 24, Pl. XIV, fig. 4, and Pl. XV, fig. 6 (1870).

Melantho (Vivipara) nolani, Tryon. Continuation of Haldeman, p. 25, Pl. XII, figs. 10-11 (1870).

Campeloma ponderosum, Say (Call). See Bull. Washburn College Lab'y of Nat. Hist., Vol. I, No. 5, p. 154, Pl. III (1886).

Shell imperforate, globosely ovate, very thick and heavy, smooth surface hardly broken by the wrinkles and delicate striæ of growth, often also with delicate revolving striæ; greenish horn-color, with irregularly disposed dark streaks, marking the edges of former peristomes, milky white under the epidermis; spire short, conic, convex; whorls 5-6, rapidly enlarging, very convex above, the body whorl very large, equaling one-half to two-thirds the entire length of the shell, imperforate axis; aperture large, oval, somewhat oblique, bluish white within; peristome externally margined with dark or black epidermis, simple, very sigmoid, broadly rounded before, suddenly curving behind and meeting body whorl at right angles, forming a deep well-marked suture, columellar portion much thickened and usually nearly reflected over the partial umbilicus, with a heavy deposit of callus on parietal wall, both above and below which it is, in old individuals, continuous across the whorl.

The length of adults varies from 20 to 37 mm., and breadth of body whorl from 15 to 33 mm.

In geographic distribution this species ranges throughout the region included between western New York, southward to northern Georgia and middle Alabama to Texas. Its greatest development seems to be attained in the Cumberland and Tennessee rivers, though very large representatives occur in the Ohio, Alabama, Coosa, Black Warrior, Oostanaula and Etowah rivers. In and west of the Mississippi it is rare, and has not been taken in that stream north of Davenport, Iowa. It is replaced in the upper Mississippi by *Campeloma subsolidum*, which here attains a size almost rivaling that of Say's species.

This is the heaviest shell of its genus in Indiana, but is an abundant one. So far as personal collections extend, the Wabash River and the Ohio alone have presented it. At numerous places in the Ohio it attains a very great size, but nowhere equaling the size which it reaches in the Cumberland and Tennessee rivers. At a station between Lawrenceburg and Aurora thousands of these shells were taken in one afternoon, and from them hundreds of the finest selected. In muddy bottoms, crawling on the bottom and half hidden after the fashion of the marine *Lunatia*, these shells are always to be taken at this locality. In the northern part of the State they are replaced by two of the following forms, *Campeloma integrum* and *Campeloma decisum*. *Campeloma rufum* also abounds in some streams.

CAMPELOMA SUBSOLIDUM Anthony. Plate 11, figs. 1 to 7.

Paludina subsolida, Anthony. Proc. Phil. Acad. Nat. Sci., p. 71 (1860). Also, Binney, "Land and Fresh-Water Shells of North America," Pt. III, p. 50, fig. 104 (1865).

Paludina exilis, Anthony. Proc. Phil. Acad. Nat. Sci., p. 71 (1860).

Paludina milesii, Lea. Proc. Phil. Acad. Nat. Sci., p. 156 (1863).

Vivipara exilis, Anthony. Tryon in Continuation of Haldeman, p. 33, Pl. XIII, fig. 7 (1870).

Vivipara (Melantho) subsolida, Anthony. Tryon in Continuation of Haldeman, p. 29, Pl. XII, figs. 1-2 (1870).

Campeloma subsolidum, Anthony. Call, in Bull. Washburn College Lab'y Nat. Hist., Vol. I, No. 5, p. 155, Pl. IV (1885).

Shell elongately ovate, imperforate, thick and heavy, sometimes malleate; epidermis light green, in old specimens horn-color or light brown; spire produced, conic, with six or seven somewhat flattened whorls, sutures distinct and deeply impressed; aperture broadly ovate, rounded before, angled posteriorly, white within; peristome continuous, with heavy callus over the parietal wall, margined with black epi-

dermal tissue, much wrinkled around umbilical axis; body whorl equaling three-fourths entire length of shell, obtusely angulated at periphery and flattened above to near the suture. The lines of growth appear to be unusually strong.

Very large specimens of this form are occasionally found. The extreme length of the largest specimen employed in framing this diagnosis was: Length, 49.30 mm.; diameter, 27.62 mm.; length of aperture, 25.40 mm.; breadth, 17.24 mm. The usual size of mature individuals is perhaps two-thirds these dimensions.

This shell is easily told from the preceding by its greater length and the flattened upper half of the body whorl; *ponderosum* has a very short spire, and the whorls are more convex. I have taken it in the Ohio, Wabash, Kankakee, and Eel rivers. It is common in similar stations to the last named.

CAMPELOMA DECISUM Say. Plate 10, figs. 1, 2, 3.

Lymnæa decisa, Say. Nicholson's Encyc. Am. ed.; first edition (1817); second edition (1818), Pl. II, fig. 6.

Paludina decisa, Say. Nicholson's Encyc. Am. ed.; Corrections to ed. 1 (1817); American Conchology, No. 1, Pl. X* (1830).—Binney's edition of the same, p. 49 and p. 159, Pl. X, fig. 1, and Pl. LXX, fig. 6.—Haldeman's "Monograph of Fresh-Water Univalve Shells," p. 4, Pl. I, figs. 1-6, fig. 4 reversed.

Paludina incrassata, Lea. Proceedings Am. Phil. Soc., Vol. II, p. 243 (1842).

Paludina decapitata†, Anthony. Proc. Phil. Acad. Nat. Sci., p. 71 (1860).

Melantho decisa, Say. Binney in "Land and Fresh-Water Shells of N. A.," Pt. III, pp. 41 *et seq.*, figs. 79-83 (1865).

Melantho (Paludina) coarctata, ex auctores in partim, non Lea (=C. subsolidum, Anthony).

Melantho melanostoma, Currier (MSS.?).

Campeloma decisum, Say. Call, Bull. Washburn College Lab'y Nat. Hist., Vol. I, No. 5, pp. 156-157 (1886).

Shell ovately elongate, not heavy or thick, imperforate, with strongly marked lines of growth, which sometimes give a roughened appearance to the otherwise smooth surface; epidermis usually dark

* This figure is that of a typical *Campeloma ponderosum*, and, evidently, is not the same shell or species described as *decisa*. By reference to Plate XXX of the "American Conchology," where *ponderosum* is figured (fig 1), the relation of the specimens may be clearly seen. Say's original figure of *decisa*—our figure—could clearly not have been drawn from any variety of *ponderosum*.

† Mr. Binney (*loc. cit.*, p. 65, fig. 129) supposes this to be a *Lithasia*!

green with depositions of black pigment marking the locations of numerous former peristomes, in the young with numerous minute epidermal hairs; whorls five and a half to six, often truncated at apex, leaving from one and a half to three and a half whorls, very convex, the last equaling more than two-thirds entire length of shell; aperture broadly oval, much rounded anteriorly, very oblique, two-thirds the height of last whorl, bluish white within; peristome continuous, less sigmoid than in most species of the genus, slightly thickened near axis, simple, acute, margins joined by a slight callus on the parietal wall; sutures deeply and regularly impressed. Operculum as usual in the genus.

Length of mature specimens 15-40 mm., breadth of body whorl 10-21 mm.

The species is the earliest described of the genus, the types probably coming from some locality in the Middle Atlantic States. Contrary to usual custom, Say omitted to give this item in his original description. By common consent, however, the name is applied to a form which occurs abundantly east of the Appalachians, though occurring also in the drainage area of the great lakes in Michigan.

This shell is found in the northern half of the State, being especially common in the St. Mary's and St. Joseph rivers, in the Maumee, the Kankakee, and in numerous small lakes. The lake shells are very much thinner than the river forms, are lighter in color and smoother on the body whorl. The well rounded character of the aperture and the regularly convex whorls, joined to the bluish-white color of the interior, will help to separate this shell from its congeners.

CAMPELOMA RUFUM Haldeman. Plate 11, figs. 8, 9.

Paludina rufa, Haldeman. On p. 3 of wrapper to "Monograph Fresh-Water Moll.," Pt. III, Pl. III, fig. 1 (1844).—Binney in "Land and Fresh-Water Shells of N. A.," Pt. III, pp. 49-50, figs. 102-103 (1865)—as a synonym under *Melantho decisa*, Say.

Melantho gibba, Currier, American Journal of Conchology, Vol. III, p. 112, Pl. VI, fig. 3 (1867).

Vivipara (Melantho) rufa, Haldeman, Tryon in Continuation of Haldeman, p. 22, Pl. XII, fig. 12 (deformed), (1870).

Vivipara (Melantho) gibba, Currier, Tryon in Continuation of Haldeman, p. 27, Pl. XII, figs. 3-7, (1870).

Campelema rufum, Haldeman. Call, Bull. Washburn College Lab'y of Nat. Hist., Vol. I, pp. 158-159 (1886).

Shell imperforate, elongately ovate, thick, somewhat roughened by growth lines, often malleated on body whorl near posterior angle of

aperture, with distinct and well-marked revolving striæ; epidermis dark olive shading to light green or even light horn-color on superior aspect of whorls near the suture, locations of former peristomes distinctly marked by dark brown or black sigmoid streaks, polished; shell reddish under the epidermis and with uniformly pinkish entire apex; whorls five and one-half to six and one-half, slopingly convex, most convex near the suture where they are also slightly angulated; aperture slightly oblique, ovate, two-fifths length of entire shell, reddish within, except near peristome where the aperture is bluish-white; peristome sigmoid, simple, acute, columellar portion thick and white, slightly reflected over the imperforate axis; parietal wall, in mature specimens, usually covered with a white callus which is thicker near the terminations of the peristome.

Length, 25.16—50.42 mm.; breadth, 13.74—25.12 mm.

This most characteristic form occurs in numerous localities from southwestern Connecticut to Iowa, in the Cedar River where it is abundant, and southward to the Hiawasse River, in Tennessee (Mrs. Geo. Andrews). It is very abundant locally, especially in the Erie canal, at Mohawk, New York, whence the writer collected the largest specimen indicated in the above measurements, and also in the canal at Columbus, Ohio (H. Moores). This last locality furnishes specimens nearly or quite as perfect as the New York locality. Dr. C. E. Beecher has communicated specimens from Waterbury, Conn., that are remarkable for small size and most beautiful pinkish and lustrous epidermis. They come from a region deficient in limestone, and respond accordingly, in size, to this feature of environment. The average dimensions of sixteen mature specimens from this locality were for length 17.42 mm., for breadth 11.06 mm.

Numerous specimens of *C. decisum* and the slighter forms of *C. subsolidum* have been received from collectors under the name of *C. rufum*. The majority of them indeed presented, until well cleaned, a rufous appearance when the interior was viewed by transmitted light, but such tints were evidently caused by the ferruginous deposits on the exterior of the shell. There is no need to mistake the true *C. rufum* if only care be taken to examine the substance of the shell beneath the epidermis, which is reddish, and the entire apex, which is invariably—from the embryonic to the senile form—pinkish.

This shell is common in many localities in Indiana, but is not so widely distributed as some other species; there are no specimens known to have been found in the southern portions of the State. I have seen specimens from Indianapolis, Lafayette, Huntington, and Fort Wayne, in rivers, and about thirty specimens from Tippecanoe and Turkey

lakes. The preceding remarks will serve to distinguish it from other forms of *Campeloma*.

CAMPELOMA INTEGRUM DeKay. Plate 11, figs. 10-12.

Paludina heros, DeKay (*olim*), Natural Hist. of New York, Pt. I, Zoology, p. 86 (1843); *Paludina integra*, Say, DeKay, *ibid.*, p. 85, Pl. VII, figs. 132a, 132b. Binney in "Land and Fresh-Water Shells of N. A.," Pt. III, pp. 47-50, figs. 96 (based upon Say's typical specimens), 97-101.

Melantho integer, DeKay, Lewis in Proc. Phil. Acad. Nat. Sci., Pl. XXII, figs. 1-4 (all aberrant forms).

Campeloma integrum, DeKay, Call, Bull. Washburn Coll., Lab'y of Nat. Hist., Vol. I, No. 5, pp. 160-161 (1886).

Shell imperforate, elongate, somewhat produced, somewhat roughened by the very numerous and crowded growth lines, with indistinct revolving striae; epidermis light horn-color or light green, transversely marked with the numerous darker lines which indicate former peristomes, polished; substance of the shell chalky white; whorls seven and eight and one-half in mature individuals, the last large, somewhat flattened on periphery, equaling two-thirds entire length of shell, slopingly convex and somewhat angled near the almost canaliculate and deep sutures; aperture nearly or quite parallel with the columellar axis, broadly ovate, milk-white within; peristome sigmoid, retreating near the broadly rounded anterior of the aperture, simple, sharp, slightly reflexed, however, over the imperforate axis, continuous over the parietal wall by chalk-white callus.

Length, 18—47.60 mm.; breadth, 18.24—24.06 mm.

There is little doubt that this is the true *heros* of DeKay and should, perhaps, bear that name. He, however, included the form which Haldeman afterwards properly separated under the name of *rufum*, for he states that his *heros* is sometimes reddish within. Say's *Paludina integra* could certainly not have been this species, which does not occur, as seen below, far west of the Appalachians, and he refers his type to the "waters of the Missouri." The length assigned the typical specimen has been justly, no doubt, assumed to be a typographical error. Binney's figure of *integra*, Say (p. 48, fig. 96, *loc. cit.*), does resemble DeKay's *integra* (= *heros*) and it is quite possible that the locality indicated by Say is also erroneous. If this supposition be correct, then Say's name must stand after the species, and *heros* be written as its synonym. DeKay himself was apparently convinced of the identity of *integra* and *heros*, but wrongly if the typical *integra* of Say came from west of the Mississippi. The figure above noticed,

from the typical specimen preserved in the Philadelphia Academy's collections, might refer to a somewhat globose form of *C. subsolidum* which occurs abundantly in the Missouri River at many localities.

C. integrum DeKay is found abundantly in central New York, from whence it ranges westward to Michigan and central Ohio. It appears to be numerous in the upper waters of the Ohio, but, so far as accurate records go, does not appear in that stream below the junction of the Monongahela and Alleghany rivers. In the canal at Columbus, Ohio, this form and *C. rufum* occur associated (H. Moores), as they also do in various portions of central New York, with the additional association of *C. decisum*. It is a very easy matter to separate these forms. This fact, considered in connection with constantly identical environment, should be weighed well in deciding their claims to specific value. The nearest relatives of *C. integrum* DeKay are, on the one hand, *C. ponderosum* Say, and *C. obesum* Lewis, on the other, the three appearing to constitute a natural sub-group, though not in the sense which would assign to them subgeneric value.

This species is common in the northern portions of the State; it is not found all over Indiana, and really belongs to the eastern fauna. The elongated character of the aperture is its chief distinguishing feature, but the well shouldered whorls may also aid in its elimination. The whole group of *Campeloma* is very difficult, and long study is required to become perfectly familiar with them. I am of the opinion, after 25 years of study, during which time thousands of these shells have passed through my hands, that all the five Indiana forms herein listed are good species, so far as species go. In the Call Collection, at the Museum of Comparative Zoology, Cambridge, there are several thousands of finely selected examples from all over the section of the United States in which they occur; these show many characters which smaller collections would not indicate. Any one making a monographic study of these forms should consult that collection because of the wealth of this material in it.

FAMILY STREPOMATIDÆ.

GENERAL REMARKS.

This family is represented by five genera in the waters of Indiana, and all are common. The shells are all operculated, thick and generally heavy. Many of them are variously ornamented with colored revolving bands; others are adorned with small tubercles. Their habits are all very similar; they may be found clinging to rocks and

stones in the more swiftly flowing portions of the rivers and creeks, or they are to be taken crawling on sloping and muddy banks in shallow water. The genera *Anculosa* and *Goniobasis* especially are found clinging to rocks covered with confervoid growths; the genus *Pleurocera* is a mud-loving form; while *Lithasia* abounds on rocks at the Falls of the Ohio in swiftly flowing water. All are vegetarians. The animals progress slowly, and all have a long and retractile proboscis; this organ is, in all Indiana species, banded with orange or yellow or brownish transverse stripes; at its end is placed the mouth, which is usually marked by two lighter semicircular or lunate color bands at the margin. The animals of most species are dark slate color.

The Ohio River contains the greatest number of species and individuals; they occur by bushels on the Falls of the Ohio. As many as a half barrel of them were collected by me in 1893, and they have not yet all been worked over, though the species are comparatively few in number. During low water on the Falls these animals congregate in the pools and cracks of the rocks in which a little water remains and may be taken by dippers a quart or more at a time. Abundant as they are here, the Coosa River, Alabama, presents still greater numbers. The whole group is very extensive and is in a sad state of confusion; the synonymy is something enormous. Of all American shells these are the most variable, responding at once to temperature, food and other changes in environment.

ARTIFICIAL KEY TO THE STREPOMATIDÆ.

- A. Shell conic, attenuated, thick, aperture produced into a more or less marked canal. *Pleurocera.*
- B. Shell thick, heavy, tuberculate. *Angitrema.*
- C. Shell body whorl large, angular, aperture small, with or without color bands, sometimes with large tuberosities on upper edge of body whorl. *Lithasia.*
- D. Shell slender, whorls rounded, aperture rounded in front, banded. *Goniobasis.*
- E. Shell oval, thick and heavy, columella thickened, aperture rounded angulate. *Anculosa.*

GENUS PLEUROCERA.

PLEUROCERA UNDULATUM Say. Plate 12, fig. 24.

Shell large, elevated, conic, brownish, with a broad, equally impressed band; inferior boundary of the band elevated and deeply crenate; superior boundary elevated and sometimes nodulous; volutions at least eight, not convex; suture not impressed, hardly obvious,

undulated by revolving on the inferior crenate boundary of the impressed band; labrum near the base, much protruded; sinus very obtuse. * * * Length one inch and four-tenths. (Say.)

On the Falls of the Ohio this species is very uncommon, but near Charleston Landing it is abundant. The sub-canaliculate character of the body-whorl, the coarse striations, due to the lines of growth, and the irregularly arranged nodules on the lower border of the body-whorl are the main distinguishing characters. The aperture is rhomboid and the interior is white, with an occasional brownish band near the lower border. The sutures are quite irregular. Perfect examples have nine to eleven whorls.

PLEUROCERA MONILIFERUM Lea. Plate 12, fig. 25.

Shell tuberculate, thick, pyramidal, yellowish or greenish, banded or without bands; spire high, pyramidal; sutures irregularly impressed; whorls about ten, flattened, striate below, sometimes obscurely sulcate, tuberculate on the periphery; aperture rather large, rhomboidal, within either white or salmon and generally double banded; outer lip acute, very sinuous; columella thickened below and very much twisted. (Lea.)

This shell is found in association with the preceding and is more common than it. It is also abundant in the Wabash near New Harmony, and near Terre Haute. I am not sure but that large series will compel the two forms to be united under Say's older name. The rounded tubercles are seen only on the body-whorl and are not near the suture but at the middle of the whorl, which fact will enable separation from the preceding. The nodulous character is by no means constant and is very marked in some while it is indistinct in other specimens. Most of the specimens seen are honey-yellow in color and nearly all are banded; some are unicolored. The columella is quite twisted and has a low carina near its base. In some specimens the columella is purple, but rarely so.

PLEUROCERA CANALICULATUM Say. Plate 12, figs. 19, 21, 23, 26, 27.

Shell tapering, horn-color; volutions about seven, slightly wrinkled; spire towards the apex very much eroded, whitish; body with a large obtuse groove, which is obsolete upon the whorls of the spire in consequence of the revolution of the suture on its inferior margin; this arrangement permits the superior margin of the groove only to be seen on the spire, in the form of an obtuse carina on each of the volutions; aperture bluish white within, with one or two obsolete

sanguineous lines; labrum slightly undulated by the groove and with a distinct sinus at the base of the columella. (Say.)

This shell was described from the Falls of the Ohio, where it is exceedingly abundant. It is a most variable species and has a wide range of colorings, number of volutions, size and height of spire, form of aperture, and development of the channel on the body-whorl. I have collected thousands of this shell on the Falls and have marvelled at their great range of variation. Many specimens are entirely purple, some are entirely salmon-colored, others have a single revolving band, some have three, most have two; the aperture is also variable; many have well rounded whorls without a sign of channel, hundreds are unicolored, honey-yellow being the prevailing color. The spire in some forms is conic, in others ovate, and in others still very acute and narrow; the young are mainly sharply carinate, but this feature is lost with age. Near Charleston, on the Ohio, this shell attains a very great size and is dark brown in color. In short, I know no shell which could be such a mine for the species monger as this one. It is a most fortunate circumstance that none of that ilk lives at the Falls!

PLEUROCERA SUBULARE Lea.

Shell rather small, thin, elevated and acutely turreted, horn-color; apex acute; whorls about 12, flat, carinate on the middle of the body-whorl; base angulated; aperture white and one-fourth the length of the shell. (Lea.)

This shell has been taken in the Maumee at Fort Wayne, the Wabash at Huntington, the Eel River near North Manchester, the Kankakee, and the Wabash at Terre Haute. It is exceedingly abundant in Lake Tippecanoe. It can not well be confounded with any other strepomatid, from the fact that the spiral whorls are sharply carinate; the region of the body-whorl below the angulate periphery is yellowish and much lighter than the rest of the shell. There are a number of fine revolving lines on most specimens on this portion of the shell. In the Wabash at Lafayette, on the muddy banks of the river within the city limits, this shell occurs in thousands. The color bands are not always present; and there are often taken specimens which are entirely purple. The epidermis is usually highly polished in perfect individuals.

PLEUROCERA ELEVATUM Say. Plate 12, fig. 20.

Shell gradually attenuating to the apex, slightly and irregularly wrinkled, olivaceous; suture not deeply impressed; volutions nine or

ten, with several more or less elevated revolving lines, of which one being more conspicuous gives the shell a carinated appearance; aperture oblique, equaling the length of the second, third and fourth volutions conjunctly. Length, one inch; breadth, two-fifths. (Say.)

This is another very imperfectly described strepomatid; it is impossible to tell what fact Mr. Say had in mind in stating that the aperture "equaled in length the second, third and fourth volutions conjunctly," which is most certainly not true, either of this or any other strepomatid. The shell is regularly conical, very slender, and the suture has just below it a small cord-like elevation which constitutes the carina of the body-whorl. The color varies almost as much as the last described form. Specimens have been seen from the Ohio at the Falls and from Lawrenceburg. I do not know it from other streams.

GENUS ANGITREMA.

ANGITREMA ARMIGERA Say. Plate 12, fig. 17.

Shell tapering, brownish horn-color; volutions about six, slightly wrinkled; spire near the apex eroded, whitish; body-whorl with a revolving series of about five or six distant, prominent tubercles, which become obsolete on the spire, and are concealed by the revolution of the succeeding whorls, in consequence of which arrangement there is the appearance of a second, smaller and more obtuse subsutural series of tubercles on the body-whorl; two or three obsolete revolving reddish-brown lines; aperture bluish-white within; a distinct sinus at the base of the columella. * * * Length about one inch. (Say.)

It is impossible to get this shell confused with any other found in Indiana waters. The spinous character of the whorls will alone separate it. Thus far it is known only from the Wabash and the lower Ohio rivers. It does not occur as far up as the Falls and has never been found above them.

ANGITREMA VERRUCOSA Rafinesque. Plate 12, fig. 18

"Ellipsoidal, top very obtuse, base of opening obtuse, inside lip thickly plaited; four spires, the last two flattened, the other large, with several rows of warts; back of the opening wrinkled; color olivaceous-brown, opening whitish.

"Habitat, the lower parts of the Ohio.

"Length about two-thirds of an inch, not quite double the breadth." (Rafinesque.)

Such is the original description given by Rafinesque of this interesting shell. Mr. Say also described it, from the Wabash, under the

name of *Melania nupera*; since his description is more complete, I reproduce it here:

"*Melania nupera*. Shell oblong suboval; volutions five, slightly rounded; body-whorl with about three revolving series of subequal, equidistant granules or tubercles, not higher than wide, occupying the superior portion of the surface; second volution with but two series; remaining volutions with slightly elevated, longitudinal lines instead of tubercles, often obsolete; spire decorticated towards the tip; suture not deeply impressed; aperture longer or as long as the spire; sinus of the superior angle profound; labium concave, with a callus near the superior angle; columella with a slight, obtuse, hardly prominent angle above the incipient sinus, which is obvious; labrum not abbreviated above, nor much produced near the base." (Say.)

This shell is so plainly characterized by the small tubercles, arranged in definite rows on the body-whorl and spire, that it will need no additional remark to aid in identification. Like the preceding, it does not occur in the Ohio above its lowermost portions, not being found at the Falls nor above. It is abundant in the lower Wabash. It does not occur as far up as Terre Haute in my experience.

GENUS LITHASIA.

LITHASIA OBOVATA Say. Plate 12, fig. 16.

Shell subovate, dark brown or blackish, volutions nearly five; spire remarkably rounded, short; body-whorl with a very obtuse, slightly indented band or undulation, a little above the middle; aperture more than twice the length of the spire, narrow; labium polished, with a callus above; labrum not projecting near the base, subrectilinear from the shoulder to the basal curve, very convex at the shoulder; base rounded and without indentation.

Animal, foot rounded, rather longer than wide, equally rounded before and behind; above yellowish white, lined with black lines. * * * Length three-fourths; breadth nearly half an inch. (Say.)

This species is exceedingly abundant on the Falls of the Ohio and as far up the river as Lawrenceburg; it occurs near Marietta, Ohio, but is of stunted growth and evidently beyond its optimum habitat. The specimens from southeastern Indiana are not as fine, as large, nor as numerous as those from the Falls. The original types came from the Kentucky River, Kentucky, in which State, in many streams, it is a most abundant shell. The color is rarely ever dark brown or blackish, as described by Say, except in old specimens which are discolored with sesquioxide of iron, a feature very common among fresh-

water mollusks. At the Falls, where I have collected four or five gallons of them, most are honey-yellow, and many greenish yellow, bright and clean. Fully one-half of a day's collecting with scoop-net, which would result in a couple of bushels of shells, would prove to be this species. I have taken many hundreds which are purple throughout, and these may have been the color variety which Say had before him; frequently the lower portion of the aperture is purplish in color, but generally the columella is white. From all other forms this may be distinguished by the nodulous character of the body-whorl in old specimens, the very short spire, and the two calcareous thickenings, one each at the upper and lower portions of the aperture, one on the body-whorl, one on the columella; this character is a conchologic constant.

GENUS GONIOBASIS.

¹
GONIOBASIS CUBICOIDES Anthony. Plate 12, fig. 9.

Shell ovate, smooth, thick; whorls six to seven, flat, the upper ones rapidly enlarging to the body-whorl, which is broad and acutely angulated; sutures distinct, rendered more so by a sharp carination on the lower part of each whorl; aperture broadly ovate, within whitish; columella deeply indented; sinus small. (Anthony.)

I have found this shell to be abundant in a small creek near Corydon, and in the Wabash River at Huntington. It was described from the Wabash by Anthony, but, as was the case with the older naturalists, they kept exact localities secret, from selfish motives. I feel quite sure, however, that the types came from the upper Wabash, since I have never been able to find the species below Lafayette, where it is not numerous. The large and angulated body-whorl will help to separate this abundant shell. It occurs west of the Mississippi, in Iowa, and is one of the most common and characteristic shells of the smaller streams of the Ozarks in Missouri. Large and fine suites from those localities are in the Call Collection, at Cambridge. The shell has some features which resemble those presented by the common *Gonio-basis livescens* Menke, but is, I think, entirely distinct.

GONIOBASIS DEPYGIS Say. Plate 12, figs. 3, 6, 8

Shell oblong, conic-ovate, not remarkably thickened; spire as long as the aperture, or rather longer, often much eroded, with a broad, revolving, rufous line near the suture, occupying a considerable portion of the surface; whorls about five, hardly rounded; suture moderately impressed; body-whorl yellowish, with two rufous, revolving lines equidistant from the suture, base and each other, the superior

one broader, and its locality a little flatter than the general curvature; aperture ovate, acute above, moderately dilated; labium with calcareous deposit, particularly above; labrum not projecting near the base, nor arquated near its junction with the second volution; base regularly rounded. (Say.)

This shell was described from the Falls of the Ohio, where it is exceedingly abundant, possibly more so than *Lithasia obovata*, mentioned above. In the little crevices in the flat rocks, at low water, which alone contain running water, this shell congregates by thousands and may be collected by the handfuls. In that way I secured in 1893 over a peck of small strepomatids, the mass of the material being this little species. Many specimens occur without bands, some have a single one, others are entirely rufous; the columella is commonly white, often purple, reddish or salmon. But the general characters are constant. I have never found it elsewhere than on the Falls.

GONIOBASIS INTERSITA Haldeman. Plate 12, fig. 1.

Shell conic, plicated, with four convex whorls; aperture elliptical; color olivaceous.

Habitat, Swan Creek, Indiana; Mrs. Say. (Haldeman.)

I know nothing more of this species; the shell is a plicate one and it is very doubtful if it came from Indiana. In any event, the very imperfect description will fit equally well many other forms, most of which come from Tennessee. This shell has the facies of a more southern form. I introduce it on Haldeman's authority, though I do not believe it belongs to the Indiana fauna.

GONIOBASIS LIVESCENS Menke. Plate 12, fig. 11.

Shell ovately oblong, smooth, bluish flesh-color; spire conically acute; lip horn-color, produced in front, border purple; columella thinly callous, purplish.

Longitude, .7 in.; latitude, $3\frac{1}{2}$ lines. (Menke.)

This shell was described by Menke from Lake Erie. It is common enough in the original locality and in the Niagara River; the Mohawk River, New York, abounds with specimens, this shell being the most abundant strepomatid in the eastern States. In Indiana I found it exceedingly abundant in the St. Mary's and Maumee, at Fort Wayne, on rocks in the river bed. It is an unattractive species, without much coloration, except the purplish tinge on the columella. The epidermis is a thick, heavy one, dark green or fuscous, without color bands. The young are carinate on the body-whorl, the aperture well rounded

below and angular above. The shell is dark blue within the aperture. All specimens from this State are a little longer than the eastern ones, but the carinate spire is characteristic of them all.

GONIOBASIS INFANTULA Lea. Plate 12, fig. 2.

Shell smooth, fusiform, dark horn-color, much banded; spire short; sutures slightly impressed; whorls five, flattened above; aperture rather large, ovate, banded within; outer lip acute, slightly sinuous; columella purple, thickened and twisted. (Lea.)

This little shell occurs on the Falls of the Ohio at a point in Shippingport, but not elsewhere, so far as I know. I formerly expressed the opinion that this shell was a form of *Goniobasis depygis* Say,* but I am inclined now, after more complete study of many examples, to think it distinct. There are short and stumpy forms of *depygis* which greatly resemble this shell, but the whorls are far more convex than in any *depygis* which I have seen. The shape of the aperture is different. The single locality where it occurs is a fall from the old canal into the river bed at the Louisville suburb called Shippingport. It is an abundant shell.

GONIOBASIS PULCHELLA Anthony. Plate 12, fig. 5.

Shell small, thin, elongately conical, brownish horn, banded with brown; spire conical; whorls seven to eight, convex; aperture large, equaling one-third of the shell, elongately ovate. (Anthony.)

This poorly described shell is abundant in the Blue River and in a small creek at Corydon; I have also found it in a stream near North Vernon. The long spire, double and broad brownish bands and its habit of dwelling only in the smaller streams will help to separate it. Specimens could not be secured for redescription.

GONIOBASIS INTERLINEATA Anthony. Plate 12, fig. 6.

Shell thin, elongate, slender, of a grayish horn-color, alternating with narrow, brown, hair-like lines, longitudinally and closely arranged; whorls seven to eight, subconvex, smooth; sutures distinct; aperture small, elliptical, ashen gray within; columella regularly rounded, much curved at base, and with a faint indentation or notch where the outer lip meets it. (Anthony.)

Of this shell I have no personal knowledge, never having been able to secure the species. It was described from Christy Creek, Indiana, and I have introduced it for that reason. It may be but another name for some well-known shell.

* Proceedings Indiana Academy of Science, 1893, page 151.

GONIOBASIS SEMICARINATA Say. Plate 12, fig. 10.

Shell small, conic, turreted; spire acute at the apex, the four apical volutions carinate below; volutions about eight, somewhat convex; suture moderately impressed; surface, especially of the body-whorl, slightly wrinkled; labrum a little prominent near the base; within slightly tinged with reddish brown. (Say.)

Described from an unknown stream in Kentucky. It is a common shell in many streams of southern Indiana, having a close resemblance to *Goniobasis pulchella*. It is exceedingly variable, and has been many times described. From Richmond comes a form which Dr. Lea called *Melania kirtlandiana*, but it is certainly this shell. I found it in a small stream near Charleston, and in a creek near North Vernon. It probably occurs abundantly in other localities.

A number of other names have been given to Indiana shells of the goniobasic section, but they are all synonyms. To aid in properly placing them, the following list of synonyms is prepared:

Goniobasis spartanburgensis Lea = *depygis*.

Melania occulta Anthony = *depygis*.

Melania cuspidata Anthony = *livescens*.

Goniobasis louisvillensis Lea = *depygis*. Plate 12, fig. 6.

Goniobasis bicolorata Anthony = *livescens*. Tryon is in error in placing this under *semicarinata*.

Goniobasis informis Lea = *depygis*. Plate 12, fig. 4.

Meseschiza grosvenorii Lea. Abandoned genus; the single species came from the Wabash River, Indiana, and are all diseased specimens, according to Tryon; the genus appears, therefore, to have based upon pathologic *Goniobases*!

GENUS ANCULOSA..

ANCULOSA COSTATA Anthony. Plate 12, fig. 14.

Shell subglobose, with a depressed, convex spire; body-whorl ventricose, with about five costæ revolving around it; color olivaceous; aperture obovate; base regularly rounded; purplish within. (Anthony.)

This little shell, or one which I take to be this species, occurs on gravelly bars at Lawrenceburg, in the southeastern portion of the State, in the Ohio. The typical locality is Cincinnati, 20 miles away, and there is little doubt that the identification is correct. The carinate character of the shell allies it to *Anculosa carinata* Bruguiere, a form which is very abundant in the headwaters of the Ohio River. It is possible that close comparison of geographic series will make this a synonym of *carinata*.

ANCULOSA TRILINEATA Say. Plate 12, fig. 12.

Shell subglobose oval, yellowish, more or less tinged with brown; volutions about four, rounded, somewhat wrinkled; spire short, rather more than half the length of the aperture; suture not very deeply impressed; body-whorl with three brownish-black revolving lines, of which the two inferior ones are nearest together, the middle one widest, and the superior one placed nearest the suture and revolving on the spire; the middle one is concealed on the spire by the suture; aperture much dilated, ovate, acute above; labium a little flattened; labrum widely and regularly rounded, without any protrusion near the base; base slightly angulated, without any sinus or undulations; umbilicus none. (Say.)

This beautiful little shell was described from the Falls of the Ohio, where it is abundant. The globose character of the shell, the regularly rounded whorls, the circular and regular aperture, together with the broad and white or rose or purple columella, spreading over the body wall at the junction with it, will separate it. Many examples, probably one-half, do not possess the color bands. To them Lea gave the name of *Anculosa viridis*, but it must pass into synonymy. Besides the Falls, I have taken this little shell at Lawrenceburg, in the Ohio, clinging to pebbles on gravel bars.

ANCULOSA PRÆROSA Say. Plate 12, fig. 15

Shell subglobular, oval, horn-color; volutions three or four, wrinkled across; spire very short, much eroded in the old shell, so much so as to be sometimes not prominent above the body-whorl; body-whorl large, ventricose, with a very obtuse, slightly impressed, revolving band; aperture suboval, above acute and effuse; within on the side of the exterior lip about four revolving, purplish lines, sometimes dotted, sometimes obsolete or wanting; labium thickened, particularly at the superior termination near the angle, and tinged with purplish; base of the columella somewhat elongated and incurved, meeting the exterior lip at an angle. (Say.)

This large anculosid is very common on the Falls, at Louisville, and may be taken in great numbers at very low water, clinging to the flat rocks in swiftly running water. Very large examples were collected abundantly in 1893-94. The species has a wide range into northern Alabama, under a multitude of names given by Lea and others. At Lawrenceburg and at Cincinnati, Ohio, the form also occurs, but in small numbers and of small size; its metropolis is the Falls. All sorts of variations occur and typical forms are very rare; indeed, the species should have been described as a composite one,

that is, a large number of examples should be passed in review and their general characters stated. Honey yellow forms, without bands, are common, but these have purple columellas; it is rare indeed to find any examples without color in this part of the shell. The aperture is continuous in all large specimens, because of the great callus which grows from the two angles over the parietal wall. The lower angle is often twisted and produced, as seen in no other forms except its near ally and possible synonym, *Anculosa subglobosa*, from the Holston and Tennessee rivers. The broad color bands which are present in most specimens are often interrupted or broken, giving a spotted appearance to the shell which adds to its beauty. The shell grows to be very thick and heavy.

FAMILY CORBICULADÆ.

GENERAL NOTES ON THE CORBICULADÆ.

The little mollusks which constitute this group are to be found in all small streams, ponds, rivers, and lakes in Indiana. They are often seen crawling along in shallow water on bars and the margins of large streams like the Wabash and the Ohio. The smaller forms, which belong to the genus *Pisidium*, are to be taken in fine-meshed dredges on nearly all muddy banks and in the deeper waters of the lakes in the northern parts of the State. In the Ohio and the Wabash the larger forms abound; sandy shores and muddy banks usually yield many examples of them. In some localities they are, from their small size, thought to be the young—"seed shells," the boys call them—of the larger mussels, but only a casual study will serve to separate them. In the Ohio many hundreds of examples may be taken by dredging and sifting the mud which collects behind submerged logs at low water mark, and in these stations *Pisidium* may almost always be expected. In the deeper portions of the small lakes, like Turkey Lake, they may be taken from the dredge in numbers, but can there be found in no other way. They have not had the attention which their importance deserves, and the State offers excellent opportunities for their study. The young are found in the older shells, in the spring and again in the fall, and have recently been described, in the "Nautilus," an amateur conchological journal, under a number of names. Very little information beyond facts of geographic distribution has been added since Prime monographed them in 1865.

To aid in identifying these close species, the following artificial key has been prepared. All the genuine species now known from the State are included in it:

CORBICULADÆ.

ARTIFICIAL KEY TO GENERA AND SPECIES OF CORBICULADÆ.

- X. Shell large, beak central or nearly so. *Sphærium.*
 Y. Shell small, beaks terminal. *Psidium.*

Species of Sphærium.

- A. Beaks rounded, never tubercular.
 a. Large, beaks full, prominent. *sulcatum.*
 b. Beaks not prominent, hinge margin much curved. *solidulum.*
 c. Beaks full, subprominent, hinge margin nearly straight. *striatinum.*
 d. Beaks full, separated, hinge curved. *stamineum.*
 e. Beaks depressed, hinge margin nearly straight, margin of valves straw-colored. *rhomboideum.*
 B. Beaks tubercular, never smooth.
 f. Shell thin, anterior margin raised, hinge margin nearly straight. *partumeium.*
 g. Shell oblong, thin, white, beaks full and prominent. *transversum.*

Species of Psidium.

- a. Shell large, oblique, hinge margin curved. *virginicum.*
 b. Shell moderately convex, hinge margin straight. *abditum.*
 c. Shell very ventricose, hinge margin curved. *rotundatum.*

GENUS SPHÆRIUM.

SPHÆRIUM SULCATUM Lamarck. Plate 9, fig. 8.

Shell transversely oval, nearly equilateral, light in texture for its size; posterior margin somewhat more pointed; anterior rounded, base slightly curved; valves convex; beaks full, raised above the outline of the shell; posterior portion a little longer; sulcations coarse, regular; epidermis dark chestnut brown; interior light blue; hinge margin narrow, nearly a straight line; cardinal teeth small, indistinct, situated somewhat towards the anterior side, double in both valves, and so placed as to assume the shape of the letter V reversed; lateral teeth on a line with the primary teeth, large, strong and prominent.

The young is more equilateral than the adult; more compressed; it presents the shape of a quadrilateral; it is of a light lemon color, the striations are as heavy as those of the mature shell. (Prime.)

This species has been found only in the northern portions of Indiana, so far as my personal knowledge extends. It occurs in the St. Joseph River, and in the Maumee, at Fort Wayne. It is found on muddy and sandy bottoms, crawling near the margins, and may also be dredged from deeper water. I have very large and fine specimens

from Graysville, Herkimer County, New York, which greatly exceed any others I have seen in size. It is more common in the eastern United States. The broad color bands which mark certain lines of growth will help to separate this species from all others.

SPHÆRIUM SOLIDULUM Prime. Plate 9, fig. 5.

Shell transversely inequilateral, elongated, slightly convex; beaks full, not very prominent; anterior margin rounded; posterior drawn out to an angle; base slightly curved; epidermis variable, dark chestnut or brownish yellow, with sometimes a yellow zone on the basal margin; sulcations coarse, irregular; interior dark blue; hinge-margin considerably curved; cardinal teeth double, in the shape of the letter V reversed; lateral teeth large; the anterior placed at an angle with the margin; the posterior more on a continuation of the curve. (Prime.)

This species is very abundant in the Ohio River, from Lawrenceburg to Evansville, at various points at which I have collected between those limits. Its nearest congener is the next species, from which it is easily separated by the less prominent beaks and by being less pointed posteriorly. It is also a much smoother shell. In the western States, that is, west of the Mississippi River, it is replaced by the following species. This form is abundant in the old canal at Brookville, and in Turkey Lake.

SPHÆRIUM STRIATINUM Lamarck. Plate 9, fig. 6.

Shell slight, transversely elongated, somewhat compressed, inequilateral; anterior margin rounded, posterior distended, inferior rounded; beaks full, not much raised; sulcations irregular, at times so slight as to hardly be seen with the naked eye, thus giving the shell a lustrous appearance; color varying from a slight greenish-yellow to a darker shade; valves slight; interior blue; hinge-margin slightly curved; cardinal teeth double, very small, of the same size; lateral teeth larger, not very prominent. (Prime.)

I have collected this shell in numbers in the Ohio River, at Louisville and Lawrenceburg, the Wabash, at Lafayette, and in the Maumee, at Fort Wayne. It also occurred in two lots of shells sent from some lakes in the northern portion of the State. It is a larger shell than the preceding, and has a different hinge-margin; the lines of growth are also less marked and the coloration is more uniform. The blue color of the nacre is common to most of the *Corbiculadæ*, and can not be used as a specific mark. Since this shell is found in all streams, both large and small, and in a great variety of stations, it is

not surprising that it varies greatly in many of the above characters. It is sometimes quite flat, almost as much so as *Sphærium fabale* of the southern States; the young are heavily striated, and are found in the parent shell in early spring. Usually only a single specimen is borne in the parent shell.

SPHÆRIUM STAMINEUM Conrad. Plate 9, fig. 9.

Shell oval, somewhat full, inequilateral; anterior generally abrupt; posterior slightly distended; beaks very full and prominent, widely separate at the apex, often eroded; epidermis dark brownish-yellow; striae heavy; valves strong; interior blue; hinge-margin curved; cardinal teeth double, nearly obsolete; lateral teeth distinct, strong. (Prime.)

This species is confined to ponds and sluggishly flowing brooks, with muddy bottoms. I have seen specimens only from the ponds along the Wabash, near Terre Haute. The dark color of the epidermis will serve as a character by which to separate it from other Indiana forms; though the separated beaks will furnish an additional character. The species is rare.

SPHÆRIUM RHOMBOIDEUM Say. Plate 9, fig. 4.

Shell subglobular, rhombic-orbicular, equilateral; anterior margin truncated; posterior slightly angular; basal nearly straight; beaks full, but not prominent; valves slight, convex towards the beaks, gradually decreasing in fullness towards the margins; interior blue; sulcations very delicate; epidermis olive-green, with often a straw-colored zone on the margins; young shell more compressed than the adult; hinge-margin nearly straight; cardinal teeth rudimentary; lateral teeth distinct, somewhat acute, not elongated. (Prime.)

This shell is the most beautiful of its genus in the State. It is found in ponds with gravelly bottoms and in the lake regions of the northern part of the State. The dark olive green epidermis and the yellowish zones near the basal margins always enable this species to be easily distinguished. I have seen examples from the St. Joseph River, near South Bend, and from Turkey Lake. The growth lines of the epidermis are often very slight, and the shell has a polished appearance.

SPHÆRIUM PARTUMEIUM Say.

Shell rounded-oval, thin, fragile, pellucid, somewhat inflated, nearly equilateral; anterior margin very slightly distended, rounded; posterior slightly abrupt; basal rounded; beaks central, calyculate, ap-

proximate at apex; striæ so delicate as hardly to be visible; epidermis glossy, of a light greenish horn-color, with at times a zone of different shade on the basal margin; valves delicate, moderately convex, interior light blue; hinge-margin nearly straight, passing by a regular curve into the anterior margin, but curving suddenly behind so as to form an obtuse angle, causing the posterior side to appear broader, thus giving the shell a somewhat rhombiform appearance; cardinal teeth strong, assuming the shape of the letter V reversed; lateral teeth very much elongated. (Prime.)

This is a very beautiful little shell and is widely distributed over the State, in almost all sorts of stations, but it loves muddy bottoms of slow streams best. It is very thin, quite uniformly colored, and may always be separated from other Indiana forms by the raised dorsal margin of the posterior end, which is also sharper than the dorsal margin anterior to the beaks. The animal is also characteristic in coloration, the siphons being always pinkish, while the rest of the soft parts are whitish. Specimens have been seen from Corydon, Wabash, Maumee River and North Vernon.

SPHERUM TRANSVERSUM Say. Plate 9, fig. 3.

Shell transversely oblong, elongated, subinequilateral, translucent; anterior side narrow; anterior margin rounded, posterior margin subtruncate, basal very much curved; beaks placed somewhat on the anterior side, large, calyculate, very much raised above the outline of the shell; striæ very delicate; epidermis greenish yellow, of a darker shade at times in the region of the beaks; valves slight, interior bluish; hinge-margin very nearly straight, narrow; cardinal teeth compressed, in the shape of the letter V reversed, and very much expanded; lateral teeth slightly elongated. (Prime.)

This species is very abundant in the Ohio and the Wabash rivers, on mud and gravel bars and near the river's edge. It may also be taken in deep water with the dredge. It is the slightest of our forms, and is so translucent that the colors of the various parts of the internal anatomy may often be made out through the shell. It is remarkable for the length of the siphons, which often extend some distance beyond the anterior margin. At Charleston, Louisville, and Lawrenceburg this shell is very common. I have collected it from numerous localities in the eastern United States, and find the shell more commonly white than any other color. Its translucency, length, high beaks, and pink-footed animal will distinguish it from other Indiana forms.

GENUS PISIDIUM.

PISIDIUM VIRGINICUM Bourguignat. Plate 9, fig. 2.

Shell large, thick, oblique, very inequilateral; anterior side longer, narrower, rounded; posterior broader, subtruncate at end, basal margin rounded; beaks situated posteriorly, large, prominent; valves solid, moderately convex, interior light blue; striæ coarse and irregular; epidermis greenish brown or chestnut color, with zones; hinge-margin very much curved; hinge broad, two strong cardinal teeth, disposed in the shape of the letter V reversed; lateral teeth strong, short. (Prime.)

This species has been noticed by me in only one locality, the Mamee River, at Fort Wayne. It may be found in other localities in the State. It is the largest of the genus, and is coarser in general character. It occurs in running waters, in the same stations as *Sphærium*, namely, muddy bottoms and on gravelly bars. It is a rather variable shell, and may be distinguished by the general dark color of the epidermis. The beaks are not very prominent, but, like all of the genus, point towards the anterior of the shell.

PISIDIUM ABDITUM Haldeman. Plate 9, fig. 7.

Shell rounded-oval, elongated, very inequilateral, moderately convex, margins well rounded, beaks placed nearer the posterior side (?), small, slightly raised; surface smooth, striae not distinct, epidermis variable, generally light straw-color; hinge-margin very nearly straight; cardinal teeth small, separate, the anterior tooth larger, and more prominent; lateral teeth small, not much elongated. (Prime.)

This shell is very common in the Ohio and Wabash rivers, and in numerous small streams over the State. I have taken it in the old canal at Brookville. I certainly can not agree with Mr. Prime in the statement that the beaks are nearer the posterior end, and have indicated my disagreement by a mark of doubt in his original description, as quoted above. In all the thousands of specimens which I have examined, the beaks are decidedly forward of a middle line drawn through the beaks to the ventral margin. This line is to be regarded as drawn in all that part of the descriptions which speaks of the shells as being "inequilateral," not only in this species but in all the *Corbiculadae* and the *Unionidae*. It is unnecessary to say that the term is entirely erroneous and should not be used at all in descriptive zoology. The species will be all found to be very equilateral if the line be drawn from the anterior to the posterior margins, as it should be, and not downwards through the beaks. It is strange that this term

ever came to be used with such significance! A far better descriptive nomenclature would have been one which would employ medial, anterior, or posterior, in locating the beaks, and having reference to the true position and the true anatomy of the animal. All the bivalve mollusca found in American fresh-waters are equilateral and are properly only so described.

The usual muddy stations for the family will produce many examples of this form. It is a fact worthy of attention that a majority of the individuals which are collected will be somewhat heavily coated with iron oxide, which will disguise their true color. Shaken briskly in a small vial of water, with sand, this may be readily removed and the true colors brought out.

PISIDIUM ROTUNDATUM Prime. Plate 9, fig. 1.

Shell small, rounded-oval, globose, ventricose, inflated, subequilateral; anterior and basal margins rounded, posterior margin somewhat abrupt; anterior side a little longer; beaks nearly central, very large, prominent, rounded; surface glossy, yellow, somewhat darker in the region of the beaks; hinge-margin curved; teeth small. (Prime.)

A few examples of this beautiful little shell were dredged in Turkey Lake by the Indiana University Biological Station and were sent to me for identification. They are uncommonly dark in coloration, and have a brilliant and shining epidermis, in which the striæ are scarcely visible. It is closely allied to *Pisidium ventricosum*, of the eastern States, but is only about half the size of that species, and is far less rotund. It can not well be mistaken for any other Indiana species. Only the one locality named above is known to produce this shell in this State. The beaks are very full and round and approximating.

FAMILY UNIONIDÆ.

GENERAL NOTES.

This large family is richly represented in Indiana waters, as may be seen from the following pages. A great many of the oldest known and best characterized forms occur in our rivers and streams, our lakes and ponds. Many of them vary widely in minor details from the specimens which are figured and which have been used as the basis of these descriptions; but all really essential features are constant. It is unfortunate in the study of this great group that the earlier writers did not seek more carefully for characters which might prove

identities rather than look for differences that might justify species names. It is a notorious fact that the nomenclature of the family has been so seriously burdened with synonyms that, unless one has the complete literature of the group at his command, their study is attended with most discouraging difficulties. Too many collectors have sought to seize on these names and given them to a host of forms from different streams simply that they might have an abundance of exchange material and so entrap the unwary. In other cases well-known forms have been purposely described under new names, that "a type," or several of them, might be in their cabinets to give added value to them; it is unfortunately true that typical forms, even though shown to be synonyms, are greatly desired by those who make exhaustive studies of the group. That there is an immoral side to these transactions the gentlemen never stop to consider, and probably would not admit. But the fact remains that many forms are well-known synonyms, and the incautious student is "taken in" by these species mongers with forms which he afterwards learns occur, under other names, at his very door.

The heterogeneous character of the unionine fauna of Indiana does not admit of a completely arranged artificial key to the species. The various subgenera, of which we recognize but three, may be easily separated by the following brief diagnostic table of differences:

- | | |
|--|---------------------|
| a. Shell with both lateral and cardinal teeth. | <i>Unio.</i> |
| b. Shell with cardinal teeth only. | <i>Margaritana.</i> |
| c. Shell without either cardinal or lateral teeth. | <i>Anodonta.</i> |

So far as our forms go these facts are constant ones; attention having been elsewhere in this report called to proposed visionary classifications, it is not needful that they be here rehearsed. It need only be remarked that they mainly serve to make a difficult subject far more difficult still.

The great number of Uniones in the State may make the following partial key of some service by taking a well-known form as a type of a group. But, even here, it is expressly to be remembered that these divisions are not given as having subgeneric or other taxonomic value; they are presented solely to render species recognition a little more simple. That subdivisions can be made along these lines I firmly believe, but even then they will stand as artificial or laboratory devices rather than as representing natural distinctions.

AN ARTIFICIAL KEY TO GROUPS OF UNIO.

(Excluding Anodonta and Margaritana.)

- A. Shell large, smooth, radiate, umbones finely folded, straw-colored, cardinal teeth small, dimorphic. Group of *luteolus*.
- B. Shell large, smooth, radiate, straw-colored, cardinal teeth large. Group of *ligamentinus*.
- C. Shell thick, heavy, nacre purple, cardinal teeth heavy, epidermis black. Group of *crassidens*.
- D. Shell small, umbones coarsely folded. Group of *parvus*.
- E. Shell dimorphic, thin, umbones finely wrinkled, epidermis dark, radiate. Group of *subrostratus*.
- F. Shell triangular, thick, brown, nacre pinkish, umbones with few coarse apiculations. Group of *rubiginosus*.
- G. Shell thick, heavy, epidermis dark, pustulate, beaks angular, cardinal teeth thick. Group of *pustulosus*.
- H. Shell thick, heavy, tuberculate, short. Group of *cornutus*.
- I. Shell tuberculate, long, with many tuberculations over the disks. Group of *tuberculatus*.
- J. Shell thick, with scattered tubercles. Group of *lachrymosus*.
- K. Shell elliptical or circular, smooth. Group of *circulus*.
- L. Shell plicate, black, large, thick. Group of *plicatus*.
- M. Shell triangular, rayed, light straw color, umbones angular, rays interrupted. Group of *triangularis*.
- N. Shell symphyntote, wings well developed. Group of *olatus*.
- O. Shell long, slender, thick, polished, black or yellow, cardinal teeth small, dimorphic. Group of *rectus*.
- P. Shell subcircular, posterior margin dentate. Group of *personatus*.
- Q. Shell very flat, lineolate, yellow, compressed at umbones, beaks triangular. Group of *lineolatus*.
- R. Shell small, coarsely undulate on umbones, radiate, straw-yellow, dimorphic. Group of *iris*.
- S. Shell large, thick, heavy, triangular, sulcate, cardinal teeth very large and thick. Group of *obliquus*.

In using this simple key to species which have a more or less close resemblance, the student will, of course, be mainly guided by the descriptions and figures. If he attacks the anatomy he will not find that the conchological distinctions are reinforced by any marked anatomical ones. It is constantly to be remembered that the whole arrangement is a device, simply, to lead to species identification.

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SUBGENUS UNIO.

UNIO UNDULATUS Barnes. Plate 13.

Shell somewhat quadrangular in outline, thick, heavy, thicker anteriorly, plicate posteriorly and over the disks of the valves, the undulations being coarse and wide; epidermis black, or reddish, occasionally

olive-green, but dark, thick, lighter on the beaks, faintly rayed in the very young specimens; lines of growth numerous, coarse, black, raised, crowded; dorsal margin straight, sometimes raised into a thin ala, but not very high, anterior margin rounded, ventral margin very slightly rounded, posterior margin biangulate, wrinkled by the folds which extend from the disk to it; umbonal slope raised, sharply rounded, very full; posterior umbonal slope flattened, many folded, the plications being coarse and from the middle of the disk, extending downwards and backwards, those near the dorsal margin being smaller, more curved, crossing the lines of growth at a right angle; umbones full, rounded, subangular posteriorly, rounded in front, the beaks much decurved, and directed anteriorly, with from four to six small undulations or folds, light colored, raised considerably above the dorsal margin of the shell; ligament, long, thick, black, wide, raised; lunule small, heart-shaped; cardinal teeth large, heavy, double in the left and single in the right valve, with many folds or lamellæ, erect; laterals straight, thin, plate-like, long, striate near the ends; anterior cicatrices distinct, very large, deeply impressed, exceedingly roughened to hold the powerful abductors, the protractor pedis muscular impression very deep, rough, twice longer than wide; posterior cicatrices very large, scarcely or not at all impressed, confluent; dorsal cicatrices in a row on the cardinal plate; pallial line well impressed anteriorly, crenulated, slightly impressed posteriorly; cavity of the shell large, of the beaks large, deep; nacre white, posteriorly very iridescent, with dark or copper-colored patches of discoloration, scattered over the middle of the interior; the folds are conspicuous from the inside of the shell.

Large examples are found in the Ohio, Wabash, Eel and other rivers, some of which measure over six inches in length. The shell is very close to *Unio plicatus*, which is found in the same stations and is also abundant; it may be distinguished by the fact that the dorsal margin in this form is straight, in *plicatus* curved, the teeth make a wide angle in this form, in *plicatus* a smaller one, and are directed to the posterior; *plicatus* is far more round and full, its folds are disposed differently, and its beaks are directed more to the front. The two species are so close, however, that they are often confused in collections. In the small lakes of the northern part of the State *Unio undulatus* occurs, sometimes abundantly, but is smaller and more flattened. It is essentially a river form.

UNIO PLICATUS Leseuer. Plate 14.

Shell large, thick, heavy, very thick anteriorly, broadly oval in outline; epidermis black, or reddish horn-color, thick, shining on the

umbonal slopes, striate near the margins, very much so over the whole posterior portion, and remarkably imbricated, usually eroded from the beaks, save in young specimens; lines of growth numerous, crowded, raised anteriorly, giving the shell a roughened appearance; anterior margin rounded, ventral margin slightly curved, posterior margin often produced, decurved in old specimens, biangulate, the plications of the shell showing as wavy folds; dorsal margin curved, rapidly so in the region of the beaks; umbonal slope full and rounded, plicate with coarse folds from five to seven in number, which start at the anterior third and pass obliquely backwards and downwards; posterior umbonal slope flattened, with many smaller folds which curve upwards towards the dorsal margin, darker in color, very striate; umbones large, prominent, raised above the dorsal margin, declined anteriorly, with fine undulations at the tips, two or three in number, the beaks separated; ligament large, long, thick, black, very powerful, coarse and wrinkled in old specimens; lunule large, obcordate, membranaceous, black; cardinals double in the left and single in the right valve, very large, thick, heavy, roughened, with numerous lamellæ, forming, in the left valve, an acute angle, the apex of which is directed towards the beaks and the sides directed posteriorly, a line drawn through them reaching the posterior margin; the laterals long, lamellar, curved, enlarging towards the ends, nearly parallel, striate at the tips; the anterior cicatrices very large, deep, roughened with numerous plates, the edges of which form ridges in the bottom, distinct, the protractor pedis very deep, rough, and large, the anterior retractor pedis deeply impressed under the large plate of the cardinal divisions, rough; posterior cicatrices well impressed, striate, very large, confluent, that of the retractor pedis impressed immediately under the tip of the laterals; dorsal cicatrices placed in a row on the edge of the cardinal plate, numerous; cavity of the shell very large, of the beaks not very large, triangular; nacre white, iridescent, especially towards the posterior end, occasionally with a purplish tinge on the lateral teeth, sometimes blotched with brownish spots.

Very large specimens, six and one-half inches in length, come from the Wabash and the Ohio. In the ponds of Vigo County are found very large examples of this mud-loving form, and from one of these the above description is drawn. The only Indiana form with which this species could be confused is the preceding, in the description of which attention has been called to the constant differences. This shell ranges all over the State, except in the drainage of the northeastern portion, from whence I have not yet seen it. In the Kankakee and the region surrounding it is common and large. A depauperate variety comes

from the lakes of the northern portions of the State. It is a river form.

UNIO MULTIPLICATUS Lea Plate 15

Shell large, thick, heavy, plicate, broadly elliptical in outline, compressed at umbones, with the anterior umbonal slope somewhat flattened; epidermis thick, black, striate, especially so on the posterior slopes near the margin, imbricated posteriorly, olivaceous and frequently radiate in the young; lines of growth coarse, numerous, conspicuous, overlapping on the posterior slope; dorsal-posterior margin nearly straight, or but slightly curved, with ligament scarcely showing above the margin; posterior umbonal slope slightly swollen, especially in the female, subangular, coarsely and broadly plicate, siphonal openings indicated by tendency of the valves to gape; ventral margin broadly rounded, never sulcate; anterior margin circularly rounded, produced well beyond the umbonal tips, thick, heavy; umbones small, very much plicated, with irregularly placed folds which are small, usually somewhat eroded, so that embryonic shell has entirely disappeared, the beaks approximated and concentrically folded, scarcely raised above the dorsal margin; ligament large, thick, black, hidden partially between the epidermal edges of the valves, which have a tendency to be symphytose, curved parallel with the dorsal margin; lunule very small, deeply set, much lower than the ligament; cardinal teeth double in the left, single in the right valve, coarsely lamellate and striate, very large and strong, usually with a tendency to a purplish coloration, with major depression or pit immediately under the umbones; plate joining cardinals with the laterals short but thick, with numerous pit-like depressions for insertion of dorsal muscles; lateral teeth long, nearly straight, or but slightly curved, double in the left and single in the right valve, striate towards the tips only; anterior adductor cicatrix distinct from the protractor pedis, very deep, very rough, pitted, more than half anterior to the cardinals, circular in outline, the protractor pedis impression being deep, rough and rather large; posterior cicatrices confluent, very slightly impressed or not at all, with distinct growth lines; pallial line deeply and irregularly impressed anteriorly; dorsal cicatrices not in cavity of the beaks but a deep pit on the cardinals; cavity of the shell very large, with the beaks well excavated; nacre usually silver white, with purplish tinge, very iridescent posteriorly, in old specimens usually blotched with brownish or copper-colored, irregular patches.

Length seven and one-fourth inches; height five and one-eighth inches; transverse diameter two and three-fourths inches. Specimen described was from the Wabash River.

This very large and common shell is found in the Ohio and Wabash, in deep water and on muddy bottoms. The old shells are very black, and when taken from favorable stations usually present an intact epidermis. Say was familiar with this form, as will appear below, and probably obtained it from near New Harmony. It attains the largest dimensions of any shell found in American fresh waters, and is altogether interesting and beautiful.

Though Say's name of *heros* has strict priority, it can not be used, for the following reasons: It was poorly described in the beginning; it was abandoned by its author for the name of *undulatus*, which had been given to another and distinct species by Barnes, from which procedure it is clear that Say had no clearly defined view concerning this form. Lea's name and description being the first that was accompanied with figures, and being the first clearly to indicate the limits of the species, must be adopted, and his name is now in common use. Say himself said, in his description of Plate XVI, American Conchology: "I formerly considered this species, with much doubt, as distinct from the *undulatus* of Barnes, and gave to it the name of *heros*, but, notwithstanding some differences, I have concluded, after a more mature examination and comparison, that it may be with propriety referred to that species. Barnes drew his description and figure from a specimen then unique, * * * which was so eroded as not to exhibit the ornamental tubercles of the umbo and beak." To all who have seen the perfect forms of *undulatus* Barnes and *multiplicatus* Lea the marked differences in the characters of the beaks will be clear. Say abandoned his name for this form, and another student re-named it.

I have not seen a specimen of *Unio gigas* Swainson, but a specimen in the Museum Taylor, England, is figured by Reeve as coming from the Ohio River. *Vide Unio*, Plate LVI, Fig. 287, Conchologia Iconica, Vol. XVI, 1867. There can be no question that this is also *Unio multiplicatus* Lea, and that it should be placed under the above synonymy.

Reeve describes and figures a shell under the name of *Unio perplicatus* Conrad, in Conchologia Iconica, Vol. XVI, *Unio*, Plate IX, Fig. 35, which had been labeled by J. G. Anthony, but which is most certainly a specimen of *Unio multiplicatus* Lea. This specimen was then in the Museum Cuming.

UNIO GIBBOSUS Barnes. Plate 16.

Shell elongated, depressed oval, thick, very thick anteriorly and in the region of the umbones, much thinner posteriorly, pointed behind; epidermis dark horn-color, sometimes reddish, sometimes blackish, polished, rather thin, faintly radiate, with rays which are usually placed, when present, over the whole disk, but point posteriorly, sometimes numerous enough and broad enough to give the epidermis a greenish tinge on the umbonal slope, striate posteriorly; lines of growth numerous, coarse, darker, roughening the disk; dorsal margin very slightly curved, anterior margin well rounded, forming a decided angle with the dorsal margin, ventral margin commonly emarginate, sometimes oblique, posterior margin pointed, biangulate, thin; anterior umbonal slope very much rounded, sometimes almost angular, posterior umbonal slope long, decurved, with an angular carina extending to the posterior margin, lateral umbonal slope long, inflated, regularly rounded; umbones large, prominent, flattened, eroded, pointed, with two or three coarse folds which are arranged concentrically; ligament large, thick, wrinkled, light-brown in color; lunule large, oval, membranaceous; cardinal teeth double in the left and single in the right valve, short, thick, erect, wrinkled; lateral teeth thick, heavy, straight, striate, parallel in the left valve; anterior muscular impressions distinct, very deep and pit-like; posterior impressions confluent, deep, roughened, that of the retractor pedis deeply impressed at the tip of the lateral tooth; dorsal cicatrices six or seven, arranged in a row in the middle of the cavity of the beaks; pallial cicatrix well impressed anteriorly, crenulated; cavity of the shell small and narrow, of the beaks very shallow, scarcely any; nacre purple, salmon, white or livid, a most variable feature in this species. Not very iridescent.

This is a most abundant species in the larger streams of the State. In the Ohio and Wabash it is one of the commonest of shells, and in both of them is singularly thick and heavy. I have received shells from the lakes in the northern parts of the State which were flatter, thinner, and in other respects resembled the common *Unio complanatus* of the eastern United States, but the characters of the beaks and the teeth are constant factors which distinguish it. It is impossible for a careful student to confuse the two forms. The river forms are all larger than those which came from the lakes. Additional localities are the Whitewater River, the Great Miami, the White, the Blue, the Kankakee and the Eel. At Lawrenceburg it is the most common form on the bars in the Ohio.

I quote Mr. Barnes's original description:

"Shell much elongated transversely, thick and heavy, rapidly narrowed and rostrate before, narrow and rounded behind,* subcylindrical, disks somewhat compressed; anterior side very much produced; beaks flat; ligament elevated; anterior dorsal margin depressed and flattened; basal margin nearly straight; epidermis blackish brown, finely striated and deeply wrinkled transversely; nacre purple of different shades, often with a purple center and white margin. Teeth crenate; lateral tooth rough, very thick, bending downward, terminating abruptly and folded over towards the anterior of the shell." (American Journal of Science, first series, Vol. VI, pp. 262, 263, pl. 11, fig. 12, 1823.)

Mr. Lea described this form from the Ohio, with a white nacre, under the name of *Unio arctior*: he again described a slightly thinner form from the Stone River, Tennessee, as *Unio stonensis*. It will therefore be seen that the range of its variation is very great. From *Unio rectus*, the only form it is likely to be confused with, the shell may be distinguished by the character of its radiation and the coarse folds on the umbones, coupled with the very heavy lateral teeth.

UNIO RECTUS Lamarck. Plate 17.

This shell was described in 1819, by Lamarck, in the *Histoire Naturelle des Animaux sans Vertebres*, Vol. VI, p. 74, as coming from Lake Erie. His description runs as follows:

"*U. testa transversim elongata, angusto, convexa, antierius, subangulata; latere antico striis longitudinalibus obliquis, remotis obsolete. * * ** Habite le lac Erie, Michaud. Elle a presque la forme du *mytilus lithophagus*, Son test est blanc, recouvert d'un epiderme brun noiratre. Largeur, 100 millimetres."

Abundant materials from several sources, some of them Indiana specimens, permit the following description:

Shell large, smooth, elongate, compressed laterally, thick, very thick anteriorly, rounded before, pointed posteriorly, epidermis thick, black, or reddish corneous, shining, obscurely rayed with dark green, the broad rays not very apparent in old specimens, lines of growth numerous, well marked, imbricated posteriorly, and often so on ventral margin; dorso-posterior margin straight, or nearly so; posterior umbonal slopes gently rounded, becoming more angular near the beaks,

* In comparing these descriptions it must be remembered that Barnes and Say, as did some other writers, confused the two extremities of the shells, calling the anterior the posterior, and conversely. This will explain some differences in the descriptions which would otherwise be irreconcilable. I do not know how this error came to exist, but it occurred, as may be seen from this description.

much imbricated towards posterior margin; umbones small, scarcely approximating, marked, in non-eroded specimens, by many minute, fine, concentric crenulations or folds; ligament long, thick, black, sometimes dark brown; cardinal teeth double in the left, and disposed to be double in the right valve, the larger portion erect, sometimes sharp, sometimes blunt, and commonly gently posteriorly recurved, the characters of the double portion in left valve various, sometimes sharp, often blunt, or smooth rounded; lateral teeth long, lamellar, straight, finely crenulate on margins; anterior cicatrices very large, deep, striate, distinct, that of the protractor pedis impression considerably above the lower margin of the large and deep adductor cicatrix; posterior cicatrices not deeply impressed, confluent, very large, pallial cicatrix very deep anteriorly, irregularly impressed throughout, crenulate; dorsal cicatrices impressed deeply in the center of the cavity of the beaks, large, often pit-like, in old shells exhibiting two or three large scars, circular in outline, and as deep as the *protractor pedis* impression, though the posterior one is commonly oval; plate connecting the cardinal and lateral teeth not well developed; nacre usually dark purple, often pink, white or salmon; frequently the coloration is confined to the region of the cardinal and lateral teeth, the remainder of the interior being pure white.

Length, 171 mm.; breadth, 60 mm.; height, 70 mm.

This fine and large species is common in the Wabash and in the Ohio; large specimens were also taken in the Eel River, near North Manchester; smaller ones have been seen from the Kankakee, in the northwestern part of the State. The female is rather thinner in texture than the male, but it is higher from the dorsal margin to the ventral, especially at the posterior portion of the shell. In many specimens the disk is slightly wrinkled, marking the position of the ctenidia, which act as gestatory sacs. Young specimens are sometimes found in collections with the name of *Unio gibbosus*, but a glance at the beaks will serve to separate them. The epidermis is usually highly polished over the umbonal slopes; old individuals are often eradiate.

UNIO TERES Rafinesque. Plate 18.

Shell oblong, two and one-half times longer than high, smooth, rather thick, thicker anteriorly; epidermis yellow straw-colored, radiate or eradiate, reddish brown in very old specimens, lemon-yellow in the young, smooth, shining, striate only on the dorsal border posteriorly, where it is darker, thin; lines of growth pronounced but widely separated, darker in color, raised anteriorly; dorsal margin

nearly straight, anterior margin rounded, forming an obtuse angle with the dorsal margin, ventral margin emarginate, especially in the female, posterior margin acutely angulated; anterior umbonal slope rounded, posterior umbonal slope subangular, becoming inflated towards the ventral margin in the female, and produced below the ventral margin, making it arcuate; umbones small, slightly raised above the dorsal line, pointed, approximating, minutely wrinkled, with very fine folds, disposed as a very flat letter V, with its apex pointing towards the beaks, the embryonic shell showing distinctly; ligament long, thick, light brown, smooth; lunule long and very narrow; cardinal teeth double in the left and single in the right valve, triangular, small, erect; lateral teeth long, slightly curved, thin, lamellar, very iridescent, striate at the tips; anterior cicatrices large, deeply impressed, distinct; posterior cicatrices confluent, well impressed; pallial line well impressed throughout, crenulated anteriorly; dorsal cicatrices minute, disposed in a group in the center of the cavity of the beaks; cavity of the shell wide, of the beaks rather shallow; nacre silvery white and very iridescent.

Length, three to five inches; height, one and one-half to two inches; breadth, one and one-fourth to one and three-fourths inches. The females are more inflated than the males.

This dimorphic species is abundant in both the Wabash and the Ohio. It is a mud-loving form, but is very active and may be taken in shallow water on the margins of both rivers; it delights to anchor itself in the mud, a foot or two from shore, in which situations it may be taken in numbers. In outline and general shape this shell resembles *Unio rectus*, but is entirely straw-yellow in color, which alone will separate it from all other Indiana shells.

The name bestowed by Rafinesque has been given to this species, which is commonly known as *Unio anodontoides* Lea, because there can be no doubt that Rafinesque had this species before him in drawing up his description. I have deemed it wise to quote, in full, Rafinesque's description of this form, which he did not figure. Conrad, in his Monography of *Unio*, Plate XXVIII, figures this species under the name of *Unio teres*, and states that the figure was taken from a specimen in the cabinet of Mr. Poulson, a resident of Philadelphia, to whom Rafinesque had given it after himself labeling it. It would seem the history of this shell is so complete that we are no longer justified in withholding from Rafinesque the right to the name of this shell. His description is as follows:

"66. Espece, *Unio teres* (Elliptio teres). Mulette ronde. Test peu épais, bombé, elliptique, élargi, tronqué inférieurement, postéri-

eurement et obliquement; épiderme presque lisse, corné; nacre blanche, iridescente; longueur environ $\frac{2}{3}$, diamètre $\frac{3}{8}$, axe $\frac{1}{2}$ de la largeur. Appartient au sous-genre *Eurynia*. Largeur environ trois pouces. Dans la rivière Wabash; légèrement sinuée inférieurement; sommets effacés; lame longue, mince; dent crénelée décurrente." (Monographie des Coquilles bivalves fluviatiles de la rivière Ohio, Chenus reprint, Paris, 1845, supplement, pp. 29, 30.)

I do not think that an unprejudiced mind could see other than Rafinesque's species in this shell. It was described from the Wabash by that writer; under Lea's name it was described from the Ohio, as well as from the Mississippi and from the Alabama.

UNIO PHASEOLUS Hildreth. Plate 19.

Shell elliptical, nearly twice longer than high, rather thick, thinner posteriorly, very much flattened laterally; epidermis straw-colored, striate, especially near the margins, with a few broad, uninterrupted, green rays extending from the beaks and covering the whole disk, sometimes many very fine and crowded green rays take their place, thin; lines of growth coarse, numerous, raised, posteriorly imbricated; dorsal margin slightly curved, anterior margin rounded, ventral margin slightly rounded, posterior margin somewhat pointed and sub-triangular, gaping at the region of the siphons; umbonal slope very flat, the anterior umbonal slope scarcely raised, the posterior umbonal slope obtusely angular, decurved, with two depressed lines extending from the beaks to the posterior margin; umbones small, minutely wrinkled, with very fine crenulations, lighter colored than balance of shell, often eroded, scarcely raised above the dorsal margin; ligament long, pointed at both extremities, scarcely elevated, dark brown in color, rather narrow; lunule distinct, long, membranaceous; cardinal teeth small, compressed, double in the right and single in the left valve, striate, thick; lateral teeth long, decurved, double in the right valve, separating towards the extremity, thinner at same point, very striate, in old specimens very thick and heavy; anterior muscular impressions distinct, deep, that of the anterior retractor pedis deeply pitted and immediately under the anterior portion of the cardinals, the adductor deep, rather large, striate; posterior muscular impressions rather deep, distinct, that of the retractor pedis at extreme tip of the laterals; dorsal cicatrices small, in a group, pit-like, on the plate of the cardinal tooth; pallial cicatrix well impressed and crenulate anteriorly, slightly impressed and very iridescent posteriorly; cavity of the shell narrow, shallow, of the beaks very shallow; nacre pure

white, somewhat iridescent posteriorly, occasionally blotched with brownish or yellowish spots.

Length, three to four and one-half inches; height, two inches; width, three-fourths to one inch. The shell is usually very much compressed laterally.

This is an abundant shell in both the Wabash and the Ohio; it has also been taken, of very large size, in the Eel River at North Manchester. A "humped" variety was described by Mr. Lea under the name of *Unio camelus*, and again another form under the name of *Unio planulatus*, from the Ohio at Cincinnati.

Dr. S. P. Hildreth, of Marietta, Ohio, described this species from the Muskingum River, in 1828, in the American Journal of Science, First Series, Vol. XIV, pp. 283, 284. His descriptions were submitted by Professor Silliman, the editor, to Mr. D. H. Barnes, who, in a note, thought that this form was "a white variety of *cuneatus*," described by himself. It has long been known that Barnes's *Unio cuneatus* was a species which had been long before described by Lamarek under the name of *Unio crassidens*; even if this were not true, the present shell must stand as distinct under the name which Dr. Hildreth gave it. To facilitate the study of the synonymy, I reproduce here the original description:

"Shell thick and ponderous; anterior side narrowed, thin, angulated; beaks low; anterior lunule, carinated; basal margin, arcuated; anterior margin, narrow and rounded; dorsal margin, higher than the beaks; posterior margin, rounded and slightly gaping; epidermis, light olive and finely wrinkled transversely; cardinal teeth, rather small, lightly sulcated, and finely crenated; lateral teeth, very broad and thick; posterior muscular impression rough and deep; anterior one, deep and striated; nacre, pearly; cavity of the beaks, shallow, and inner surface marked with several deep folds, running obliquely from the cardinal teeth to the anterior margin."

It is to be remembered in reading this and other descriptions by Dr. Hildreth that he followed the custom of his time and called the anterior part of the shell the posterior, and conversely.

UNIO SPATULATUS Lea. Plate 20.

Shell small, elliptical, compressed laterally, about twice longer than high, thin, slightly thicker anteriorly, smooth, or slightly striate anteriorly; epidermis light straw-color, reddish on the umbones, thin, rayed with numerous wavy lines which are especially so on the posterior slope; lines of growth numerous, distant, imbricated posteriorly, crowded anteriorly; dorsal margin slightly curved, anterior margin

rounded, posterior margin biangulate, ventral margin rounded; anterior umbonal slope flattened, posterior umbonal slope flattened, scarcely subangulate near the beaks; umbones rather depressed, scarcely elevated above the dorsal line; small, decorticated, with a few rather coarse concentric and wavy crenulations; ligament long, narrow, rather thick, dark horn-color; lunule long, slender, black, membranaceous; cardinals small, thick, erect, double in the left and single in the right valve; laterals long, slender, slightly curved, thin, striate; anterior cicatrices distinct, deeply impressed, rather large; posterior cicatrices confluent, not deeply impressed, large; dorsal small, in the center of the cavity of the beaks; pallial line distinct, well impressed anteriorly; cavity of the shell small, of the beaks shallow, triangular; nacre white, iridescent, sometimes with a tinge of salmon or pink in the cavity of the beaks.

Length, from two to two and one-half inches; height, one and one-eighth to one and one-fourth inches; width, one-half to three-fourths of an inch.

This small shell occurs in most of the streams and the lakes of Indiana. In the Ohio and Wabash it is common. I have collected large specimens in the Eel River at North Manchester. It is often mistaken for the immature shell of *Unio ligamentinus*; indeed, young *ligamentinus* has often been sent to me for this species. The characters of the beak and the peculiar character of the rays will separate this form.

UNIO IRIS Lea. Plate 21.

Shell elliptically oval, thin, small, somewhat thicker anteriorly, compressed transversely; epidermis light straw color, smooth, somewhat glossy, striate near the margins, very beautifully rayed with green, the rays departing from the umbones and proceeding postero-ventrally in a straight line, becoming broader below, sometimes broad, sometimes mere pencil lines, more or less interrupted, especially at the lines of growth, thin; lines of growth conspicuous, not very close together, slightly darker than the disk of the shell; dorsal margin somewhat curved, anterior margin well rounded, ventral margin nearly straight, posterior margin biangulate, rather pointed; umbonal slopes all somewhat compressed, the lateral flattened, the posterior subangular; umbones small, slightly raised above the dorsal margin, small, angular, rather coarsely folded, lighter in color than the rest of the shell; ligament long, thin, narrow, light brown; lunule long, narrow, black; cardinal teeth small, erect, triangular, double in the left, single in the right valve, that of the right valve plate-like, slightly

curved anteriorly; lateral teeth long, thin, straight, not much elevated; anterior cicatrices distinct, deeply impressed; posterior cicatrices slightly impressed, confluent, very iridescent; dorsal cicatrices small, in the center of the cavity of the beaks; pallial impression very faint; cavity of the shell small, narrow; of the beaks shallow, small, somewhat triangular; nacre silvery white, iridescent posteriorly.

Length, two and one-half inches to three inches; height, one and one-fourth to one and one-half inches; width, five-eighths to three-fourths of an inch.

The dimensions given above are sometimes slightly exceeded, but the majority of the specimens found will fall within these limits. The species is found in all portions of the State, and is characterized by its beautiful nacre, the short, erect teeth, and the beautiful bands of green, together with the foldings on the beaks. *Unio spatulatus* is often mistaken for this shell, and does indeed resemble it in many particulars, but the differences will be seen by comparing the two descriptions which I give. The largest and finest specimens I ever saw, in many hundreds of examples, came from the El River, near North Manchester, and were collected by me in the spring of 1896. They are now in the Call Collection in the Museum of Comparative Zoology.

UNIO SUBROSTRATUS Say. Plate 22.

Shell dimorphic, inflated in the female, pointed in the male, thin, laterally compressed, narrowly elliptical; epidermis dark brown, or reddish, much redder on the beaks, thin, polished on the umbonal slopes, striate on the margins, much rayed, especially on the posterior half, by broad dark-green rays, most conspicuous over the basal half of the posterior slope, sometimes interrupted by the lines of growth; growth lines very evident, darker, crowded anteriorly; dorsal margin slightly curved, in the male nearly straight, in the female somewhat elevated; anterior margin small, rounded; ventral margin emarginate in the female, nearly straight in the male; posterior sharp or pointed in the male and biangulate, in the female emarginate, much longer, extending farther towards the dorsal margin; anterior umbonal slope rounded in both male and female; posterior and lateral umbonal slopes much inflated in the female, in both subangular; umbones small, placed well forward, pointed, approximating, lighter in color, sometimes reddish brown, with many fine concentric and curved lines that are wavy, the points extending towards the umbones; ligament long, thin, light brown, narrow, slightly raised above the dorsal margin; lunule inconspicuous, long, narrow; cardinals small, erect, thin

and plate-like, disposed to be double in both valves; laterals long, thin, lamellar, straight, not much elevated; anterior cicatrices well impressed, distinct; posterior cicatrices fairly well impressed, confluent, striate, very iridescent; dorsal cicatrices small, pit-like, in a row in the center of the cavity of the beaks; pallial line faintly impressed; cavity of shell small, narrow, of the beaks very shallow; nacre white, pearly, iridescent posteriorly.

Length, two and one-half to three inches; height, in the male little more than one inch, in the female often one and one-half inches; diameter, from three-fourths of an inch to nearly one inch, the female being somewhat more inflated, especially in the posterior half.

The shells on which this description is based came from the Wabash River; the species occurs over all that part of Indiana the drainage of which is into the Ohio. A form of the Atlantic drainage, *Unio nasutus*, is very commonly given the honor of belonging to the Indiana fauna, but no authentic specimens have yet been seen from this State. The markings on this species are quite different from those of the eastern species, and the beaks differ. Examples have been seen of *Unio subrostratus* from the Eel River, the Wabash, the White, the Blue and the Ohio. It is a mud-loving form and is often found in association with *Unio teres* and similar shells. This species occurs in a number of other States, and has been described by Mr. Lea from several of them under different names; there can, however, be no doubt of identity.

UNIO FABALIS Lea. Plate 23, figs. 1-4.

Shell very small, elliptical-oval, pointed posteriorly, compressed laterally, thick, heavy, very thick anteriorly and in the region of the umbones; epidermis olive green, thin, very light on the umbones, somewhat glossy, striate on the margins, thin, with numerous fine capillary rays extending to the margins, most marked posteriorly; lines of growth large, darker, not numerous; anterior dorsal margin very short, oblique, posterior dorsal margin long, curved downwards in the female, straight and oblique in the male, the shell being dimorphic; anterior margin subangulate rounded, ventral margin rounded, inclined to be emarginate in the female near the posterior end; posterior margin pointed, subbiangulate; anterior umbonal slope rounded, angulate towards the beaks, posterior umbonal slope subangulate; flattened on the dorsal surface; umbones very small, triangular, smooth, light-colored, somewhat decurved, approximate, embryonic shell usually retained save in eroded specimens; ligament short, narrow, thin, light brown, polished; anterior lunule long, black, membranaceous;

cardinals short, thick, heavy, erect, double in the left and single in the right valve; laterals short, thick, very heavy, curved downwards, thicker near the extremities; anterior cicatrices distinct, small, deeply impressed; posterior cicatrices small, well impressed, distinct; pallial impression very slight; dorsal cicatrices minute, in the center of the cavity of the beaks; cavity of the shell very small, narrow; of the beaks shallow or scarcely any; nacre pearly white, occasionally pink in the regions of the beaks, iridescent posteriorly.

Length, one inch to one and one-half inches; height, five-eighths to three-fourths of an inch; width, of males three-eighths of an inch, of females half an inch.

This very beautiful shell was described by Dr. Lea from the Ohio River, where it is very common. The White and Wabash rivers furnish numerous specimens; some of the lakes of northern Indiana furnish many specimens, notably Tippecanoe Lake, from which I have seen twelve specimens. There is no other species which can be confused with it except *Unio parvus* Barnes and *Unio glans* Lea, both of which are small species. From *parvus* it can readily be told by the lack of undulations on the beaks; from *glans* it may easily be distinguished by the color of the nacre, *glans* being dark purple.

Mr. Say described this shell in 1831, in the *Transylvania Journal of Medicine*, as *Unio lapillus*; Lea's description was made in 1830.

UNIO PRESSUS Lea. Plate 24.

Shell thin, rather large, very much compressed transversely, disks flattened, oval in outline, symphynote or partly so, the ligament being but partially hidden in most forms that are old, never covered in the young shell, often alate posteriorly; epidermis thin, striate anteriorly, polished over the umbonal slopes and on the disks, light horn or straw-color, with numerous capillary green rays, often disposed in very broad bands that are more or less irregular, covering the entire disk and giving the shell a bright green appearance, darker and greener posteriorly; lines of growth coarse, well marked, distant, darker than rest of epidermis; dorsal margin raised, thin, curved, alate in many specimens, in old ones the ala is commonly broken off; anterior margin well rounded, forming a very obtuse angle with the dorsal margin; ventral margin rounded; posterior margin biangulate, sometimes somewhat sinuous; anterior umbonal slope scarcely raised, flattened; posterior umbonal slope somewhat raised or swollen, especially in the female, the dorsal portion with two depressed lines extending from the beaks to the margin; umbones small, scarcely raised, angulate, with numerous coarse, wavy folds or plications, these are sometimes

apiculate, lighter colored than the rest of the shell; ligament light brown, long, thin, sometimes partially covered by the shelly matter of the valves in those specimens which are partially symphyonote, i. e., in those specimens in which the valves are united above the ligament; lunule very long, narrow, light colored; cardinal teeth small, double in the left and single in the right valve, the posterior division of the left cardinal inclined to divide into two portions, thin and plate-like, the two main divisions widely separated; the laterals small, straight, thin, the lower plate often incomplete; both hinge teeth are often greatly roughened or nearly aborted through disease; anterior muscular impressed shallow, large, distinct, smooth; posterior cicatrices very lightly impressed, confluent; pallial cicatrix scarcely evident; dorsal cicatrices small, impressed on the cardinal plate; cavity of the shell large, narrow, of the beaks rounded and shallow; nacre usually white, but often tinged with salmon in the middle of the disk and the region of the beaks, often roughed through some pathological condition, when perfect quite iridescent.

Length, three to four inches; height, two and one-half inches; width, three-fourths to one inch.

This species is distributed over all of Indiana, in the rivers, creeks and in many lakes. It is not easily confounded with any other species, the characters of the teeth and the outline, coupled with the rays, will separate it. The above description is based upon specimens from the Wabash River.

This shell has been greatly misunderstood by recent writers, and some of them have attempted to place it among the *Margaritanas* under the older name of *Alasmodonta*. I find it so placed in two late papers, one of which deals with the mollusca of the Chicago area, but without warrant of fact either so far as relates to the shell or to the soft parts. It is the bane of the student of shells that some systematists seize upon novel views and accept them as true; after wider acquaintance with species and their variable forms, and closer attention to habits they abandon these wouldbe guides and take a common sense view of things. The recent attempt to revive many long forgotten names as of subgeneric value, especially those of Rafinesque, an attempt made many years ago by Agassiz and by Stimpson, which failed, and the fact that inadequate materials seem to be at hand for this purpose in most museums, should teach us to be conservative in these matters. The most heterogeneous conglomerations are presented as being "scientific"! *Unio rectus*, *Unio alatus*, and *Unio parvus* are all being "scientific"! *Unio rectus*, *Unio alatus*, and *Unio parvus* are all presented in one subgenus—*Lampsilis*—in utter ignorance, it must be

conceded, of the radical differences between the soft parts. If *Unio* must be broken up to facilitate its study—which is by no means certain—these infractions will certainly not be the ones which will last.

UNIO ALATUS Say. Plate 25

Shell large, oval, inflated, alate, symphyntote, rather thin, slightly thicker before, gaping posteriorly; epidermis dark olive, or brown, sometimes black, thick, striate posteriorly, coarsely so on the dorsal slope, rayed inconspicuously, the green rays extending from the beaks to the ventral margin and being directed posteriorly; lines of growth very coarse, rough, often raised into low ridges, black; dorsal margin triangularly alate in perfect specimens, the valves connate, including the ligament; anterior margin rounded; ventral margin slightly rounded; posterior margin biangulate, not regular, usually incurved near the siphons, very long; anterior umbonal slope compressed; posterior umbonal slope inflated, full, rounded, the dorsal portion with two or three carinæ which extend from the beaks to the posterior margin in the region of the siphons and where the epidermis is thick and coarsely striate, becoming very flat on the alæ; umbones very small, slightly raised above the dorsal margin, smooth or very finely wrinkled, when not decorticated which is the rule, in color lighter than rest of umbones, placed well towards the anterior; ligament long, thick, light horn-color, hidden by the connate valves in perfect specimens; lunule not evident; cardinals double in both valves, the teeth of the left valve being somewhat thicker, all erect, roughened, usually somewhat curved anteriorly, short; lateral teeth long, curved, double in the left and single in the right valve, becoming thin and plate-like near the posterior ends; anterior muscular cicatrices large, distinct, well impressed, that of the anterior retractor pedis being especially well marked, that of the protractor pedis very large, round, deep; posterior cicatrices slightly impressed, confluent, very large, beautifully iridescent; dorsal cicatrices numerous, large, placed in a straight line in the middle of the cavity of the beaks; pallial cicatrix well impressed anteriorly; cavity of the shell large, of the beaks shallow; nacre purple or pinkish, sometimes with copper-colored blotches, iridescent, especially posteriorly.

Specimens are occasionally taken which are seven inches in length, with corresponding other dimensions. Usually as seen in the Ohio, Wabash and Kankakee rivers the shell is about five inches in length.

There are several forms of the alate *Unionidæ* in the Wabash and the Ohio, but they are easily separable from this form of Say's. *Unio lævissimus* Lea is thinner, darker, and flatter; it also has slighter teeth

and never attains the large size of Say's species. *Unio gracilis* Barnes is a light-colored shell, with light green rays, is less alate, has a white nacre and different beaks. The habits of all these shells are very similar, being found in soft muddy bottoms and in deep and still waters; they are mud-loving forms.

The specimen figured came from the Wabash, and is a diseased specimen, the ligament being distributed all over the inside of the connate alæ. Pink pearls are common in this species.

UNIO LEVISSIMUS Lea. Not figured.

Shell large, thin, laterally compressed, fragile, gaping posteriorly, symphyntote or connate, bialate, smooth, broadly oval in outline, rayed indistinctly; epidermis smooth, brilliantly polished, dark horn-color, lighter on the umbones, sometimes lighter horn-colored, with faint capillary rays which become striations on the posterior marginal slope, epidermis thin, usually eroded from the apices; subbiangular behind, rounded before, ventral margin nearly straight; lines of growth very distinct, darker, sometimes black, impressed, in old specimens inclined to be imbricated posteriorly; ligament inclosed, thin, light horn-color; lunule none; lateral and anterior umbonal slopes depressed and flattened, scarcely rounded; posterior umbonal slope flat, flattened on the margin dorsad, darker in color, with two or three faint carinæ extending to the siphonal openings; cardinal teeth small, depressed, thin, plate-like, striate, single in both valves, in the left valve the main tooth is reinforced by two minute ridges on either side, in the right valve by one minute ridge dorsad to the main tooth; lateral teeth long, slightly curved; not connected by a plate with cardinals, thin, plate-like, faintly striate near the ends; anterior cicatrices distinct, large, scarcely impressed, smooth; posterior cicatrices very large, confluent, not at all impressed, smooth, iridescent; pallial line scarcely evident; dorsal cicatrices large, slightly impressed, arranged in an irregular row in the cavity of the umbones posterior to the beaks; nacre rosy, or purplish, beautifully iridescent, especially posteriorly; umbones small and scarcely elevated above the margin of the shell, approximated, subbiangular behind, with very fine crenulations in the very young specimens.

Four to five and one-half inches long; three and one-half to four and one-fourth inches high.

This shell is common in the Ohio in muddy stations associated with *Unio alatus* and *Margaritana complanata*, and other mud-loving shells. The bialate character is a constant one, the valves being connate both in front and behind the small umbones. The chief char-

acter, additional to these, is the one afforded by the peculiar cardinal teeth which are quite unlike those of any other *Unio*. They are directed close to the dorsal margin and are not connected with the laterals by any sort of plate, a circumstance which few *Uniones* present. The only shell that this one could be confounded with is *Unio alatus*, which is, however, a much heavier and far coarser shell; the polished epidermis will alone distinguish it from that form; from *Unio gracilis* the absence of bright green rays will separate it.

The specimen described came from the Ohio, and is number J1770 in the Collections of the American Museum of Natural History, New York City. It was loaned for description by courtesy of Professor R. P. Whitfield.

UNIO TENUISSIMUS Lea. Not figured.

Shell small, thin, smooth, elongately-elliptical in outline, very greatly compressed transversely, symphynote, epidermis greenish horn-color, radiate, striate near the margins; lines of growth inconspicuous, slightly darker; dorsal margin straight; anterior margin abruptly rounded; ventral margin broadly rounded; posterior margin pointed, subangular, oblique towards the dorsal margin, gaping in the region of the siphonal openings; anterior umbonal slope scarcely rounded, lateral slope flattened; posterior umbonal slope subangular, greatly compressed laterally near the alæ; umbones very minute, scarcely projecting above the dorsal margin, approximate, subangular; ligament small, short, thin, hidden by the valves, light horn-color; cardinal teeth scarcely evident in the left valve, single in the right valve, short, thin, sharp in the right valve; lateral teeth single in both valves in the specimen from which this description is drawn, long, thin, straight; anterior cicatrices distinct, well impressed, except the protractor pedis, which is scarcely evident; posterior cicatrices confluent, not at all impressed, very iridescent; pallial line not evident; dorsal cicatrices large but scarcely evident in the cavity of the beaks; cavity of the shell shallow, of the beaks scarcely any; nacre bluish white and very iridescent.

This is one of the thinnest of shells, as its name implies; it is found in muddy bottoms in the Ohio and Wabash rivers. It is fairly common, but is not an abundant species. It has no close relative, and can not be mistaken for any other species in the State; notwithstanding this, it is occasionally seen in collections mixed with *Anodontas*. so very like that genus do some specimens seem to be from the poorly developed character of the teeth.

UNIO GRACILIS Barnes. Not figured.

Shell large, symphynote, rather thin, slightly thicker anteriorly, broadly elliptical in outline, compressed laterally, a little higher posteriorly; epidermis light horn or straw-color, indistinctly radiate (in young specimens the rays are much more distinct), smooth, shining on the umbones, striate near the margins; lines of growth coarse, raised, giving old shells a rough appearance, often irregular through breakage and repair; dorsal margin somewhat curved; anterior margin a little produced, rounded, subangular; ventral margin ovately rounded; posterior margin circularly rounded; anterior umbonal slope flattened, lateral umbonal slope compressed; posterior umbonal slope rounded, somewhat inflated, compressed near the dorsal margin, darker in color, with two indistinct carinæ extending from the beaks to the margin; umbones very small, scarcely raised above the dorsal margin, approximated, with a very few fine folds or crenulations in perfect specimens, about one-third the length of the shell from the anterior margin; ligament thick, included between the symphynote valves, light horn-color; lunule long and thin; cardinal teeth very small, smooth, double in the left and single in the right valve, in some specimens almost wanting; lateral teeth curved, becoming evident as teeth only near the posterior margin, elsewhere they are but rounded folds, perfectly smooth; anterior cicatrices very large, distinct, well impressed; posterior cicatrices very large, confluent, slightly impressed, crenately striate; pallial line iridescent, faintly impressed, very broad; cavity of the shell large, of the beaks very shallow; dorsal cicatrices large, in a row in the cavity of the umbones, but not under the beaks, extending anteriorly; nacre pink to rose color, very iridescent, especially on the dorsal and posterior margins.

Length, five and one-half inches; height, three and one-half to four inches; width, one and three-fourths inches.

This large and fine shell is very fragile, and does not well stand the changing temperature of cabinets; as a result the valves crack and become disfigured. It is a very common shell in many Indiana streams. The specimen described came from the Ohio River. It is, like all the symphynote shells, a lover of the mud, and is found in quiet and deep waters in association with many of the common species. It is rare to find a full-grown specimen in which the symphynote character is to be seen, since the alæ are most often broken off. But the young shells show the character well, and occasional large specimens show it in greater or less degree. The characters of the cardinal teeth will alone separate it from any other American shell. Mr. Barnes described his species from the Wisconsin River;

it would seem that Say originally regarded this as a variety of *Unio alatus*, but it is widely distinct.

UNIO TUBERCULATUS Barner. Plate 26.

Shell quadrate-elongate, thick, large, heavy, very thick anteriorly, rather thin posteriorly, numerous elongated pustules all over anterior half of disk, resembling in form that which would be assumed by some thick fluid which was flowing in drops over the disk, flattened transversely, the female the more inflated; epidermis reddish horn-color, thick, striate, eradiate; lines of growth large, coarse, separated, darker in color; dorsal margin nearly straight posterior to the beaks, but oblique, anterior portion curved; anterior margin rounded, forming an obtuse angle with the dorsal margin; the ventral margin emarginate, posteriorly decurved; posterior margin irregular, biangulate, shape various, more irregular in the female, subtruncate in the male; anterior umbonal slope rounded, subangular towards the beaks; lateral umbonal slope long, flattened, slightly excavated; posterior umbonal slope very angular, long, especially in the female, with a number of swollen bosses on the angle which give rise to large, variously formed tubercles, inflated, especially in the female, the dorsal portion with numerous parallel fine ridges which extend to the dorsal margin, flattened near the ligament; umbones somewhat elevated, angular, pointed, separated, placed well towards the anterior margin, decurved, decorticated, with many small tubercles which, when not eroded, are rather sharp, with a strong angle which passes to the postero-ventral margin; ligament long, thick, black, very much raised above the dorsal margin; lunule long, rather broad, black, membranaceous; cardinal teeth massive, thick, heavy, very striate, double in both valves, erect; lateral teeth long, thick, straight, striate; anterior cicatrices distinct, large, deep, roughened; posterior cicatrices confluent, large, slightly impressed; pallial cicatrix well impressed anteriorly and crenulate; dorsal cicatrices small, pit-like, in the center of the cavity of the beaks; cavity of the shell large, of the beaks deep and triangular; nacre dead white, iridescent posteriorly.

Length, five to six inches, occasional specimens having been taken nearly seven inches in length; the females are longer than the males, but less high; the highest portion of the shell is just posterior to the beaks.

Abundant in all the large streams in the southern half of Indiana, especially the Wabash and the Ohio. The animal delights in muddy bottoms, and it should there be looked for, in rather deep and slug-

gishly flowing water. It can not be confused with any other species. The specimens figured came from the Wabash.

Mr. Barnes's original description appeared in the *American Journal of Science, First Series*, Vol. VI, pp. 125, 126, Plate 7, Fig. 8, 1823; it is reproduced below:

"Shell thick and rugged; anterior side compressed, narrowed thin; posterior side rounded, short, obtuse, and broader than the anterior. Beaks flat, placed about two-ninths from the posterior end; ligament higher than the beaks; hinge-margin nearly straight, elevated, compressed and carinate before; basal margin compressed, falcated; anterior dorsal emarginate, anterior basal projecting; anterior margin narrow and rounded. Epidermis dark brown or horn-color. Surface thickly and irregularly tuberculated, tubercles elongated longitudinally; those near the base larger; an elevated ridge extending from the beaks and projecting on the anterior basal edge; irregular profound, nodulous undulations radiating from the elevated ridge to the hinge and anterior margin. Cardinal teeth crenated; lateral teeth long and striated; posterior muscular impression deep, and the anterior half of it rough. Cavity angular compressed, directed backward under the cardinal tooth, admitting the end of the finger. Nacre pearly white, with irregular spots of greenish, iridescent on the fore part."

UNIO CORNUTUS Barnes. Plate 27.

Shell subcircular in outline, thick, heavy, very thick anteriorly, emarginate, tuberculate, subglobose; epidermis light horn-color, or straw-color, smooth, thin, minutely and beautifully rayed, the rays appearing as if made up of a succession of minute green spots, wavy; lines of growth distinct, separated widely, raised into low ridges anteriorly, where they are crowded; dorsal margin thick, curved; anterior margin rounded, sometimes oblique, ventral margin full anteriorly, emarginate posteriorly, posterior margin irregularly sinuate, biangulate; anterior umbonal slope full, round, angular towards the beaks; lateral umbonal slope rounded, with four or five rather large tubercles, occasionally appearing like tears flowing over the disk; posterior slope sulcate, angular, thinner and flattened near the dorsal margin, with a number of fine, curved wrinkles or folds which pass upwards towards the dorsal margin: umbones high, prominent, triangular, decurved, with one small tubercle on each, that on the right valve being formed first and placed highest; ligament short, thick, wide, usually black; lunule small, cordate; cardinal teeth large, thick, heavy, not much elevated, very crenate, double in the left and single

in the right valve; lateral teeth thick, slightly curved, short, striate; anterior cicatrices distinct, deep, small, that of the anterior retractor pedis deeply impressed on the base of the cardinal teeth; posterior cicatrices deep, distinct, that of the retractor pedis just below the end of the lateral teeth; dorsal cicatrices small, in a row on the cardinal plate; pallial line well impressed anteriorly and crenulate; cavity of the shell small, of the beaks deep and wide; nacre dead white, inclined to be iridescent posteriorly.

Length, two to two and one-half inches; height, two inches; width, exclusive of the tubercles, one and one-half inch.

This is one of the commonest *Unios* in Indiana and in all the western streams; in the Ohio it is very abundant, as it is also in the Wabash and the White. It can not be confused with any other Indiana shell. The large tubercles alone will separate it. They are arranged in alternation from the beaks down, and commonly number about four on each valve. Its nearest congener is *Unio metanevrus*. The original description of Mr. Barnes is given below:

"Shell thick, rounded behind, subbiangulate before. Beaks somewhat elevated and nearly central, with the ligament passing between them; anterior lunule long-heart-shaped, compressed, distinct by a roundish elevated ridge which ends in a projection on the anterior margin, and marked by small transverse, subnodulous wrinkles, and obsolete longitudinal furrows; surface waved and on the fore part compressed; a regular row of large, distant, elevated and transversely compressed tubercles, extends from the beaks to the basal edge, dividing the shell into two nearly equal parts. Cardinal teeth sulcated. Nacre pearly white, and iridescent." (American Journal of Science, Vol. VI, page 123, Plate IV, Fig. 5, 1823.)

The habits of this shell are peculiar in that it is to be found in almost all stations where *Unio* occurs at all, on bars, gravel beds, mud banks, deep and shallow water, in short, it is almost ubiquitous. On shallow bars it is, like *Unio cylindricus*, very active, and is commonly found crawling about. It is a common form in swiftly flowing waters, its very thick shell adapting it to such stations.

UNIO METANEVRUS Rafinesque. Plate 28.

Shell rather large, very thick, heavy, especially thick anteriorly and in the region of the beaks, trapezoidal in outline, roughly tuberculate, with large tuberosities on the posterior slope, somewhat inflated; epidermis striate, thick, dark horn-color, in many specimens with numerous arrow-shaped spots of green over the disk, between the tubercles, in some specimens the epidermis is light yellow in color; lines

of growth coarse, very numerous, imbricated posteriorly where the striations of the epidermis are most marked, very crowded anteriorly, which renders the shell very rough; dorsal margin curved, anterior margin roundly curved, long; ventral margin long, emarginate; posterior margin oblique, emarginate; anterior umbonal slope rounded, full; lateral umbonal slope inflated, tuberculate; posterior umbonal slope much raised into an increasingly wide ridge, which is nodulous, with from five to six large tubercles, that portion of the slope which is near the dorsal margin imbricated, with a number of rounded nodules arranged more or less regularly in rows; umbones large, inflated, thick, triangular, tuberculate, plicate, generally eroded, placed well forward; ligament thick, short, black, wide; cardinal teeth very large, thick, heavy, not elevated, striate, double in the left and disposed to be trifid in the right valve; lateral teeth very short, thick, curved, striate, separated from the cardinals by a rather broad plate; anterior adductors distinct, deeply and roughly impressed; posterior cicatrices distinct, deeply impressed, concentrically striate; dorsal cicatrices on the cardinal plate; pallial line deeply and crenately impressed anteriorly; cavity of the shell not large, of the beaks very deep and triangular, being excavated very deeply into the beaks; nacre white, with occasional patches of brownish or copper-colored matter.

Specimens have been taken in the Wabash, White, Eel, Kankakee, Ohio, Blue and Whitewater rivers. The shell is very common in almost all stations in the streams where it occurs at all. The figure is made from a specimen taken in the Wabash, by Professor Evermann, at Terre Haute, and is one of the most beautiful and perfect I have ever seen. It is impossible to mistake this shell; no other Indiana form compares with it. The shells that are taken on gravel bars in waters that flow rapidly are always much eroded; shells from deep water and muddy stations are usually perfect. At the Falls of the Ohio this shell is found in some numbers, its great thickness protecting it from injury. It is capable of withstanding very severe blows, but is one of the quickest to die when exposed to the air and sun when removed from the water. It is not at all tenacious of life.

UNIO CYLINDRICUS Say Plate 29.

Shell somewhat rectangular, elongate, laterally compressed, thick, especially so before, nodulous, smooth anterior to nodules, large; epidermis light yellowish, thin, with many small, triangular arrow-shaped spots of green, with apex pointing ventrad; lines of growth narrow, impressed, line-like; dorsal margin straight; anterior margin abruptly rounded; ventral margin long, slightly emarginate; poste-

rior margin emarginate, slightly oblique; anterior umbonal slope angular, full; lateral umbonal slope straight, flattened; posterior umbonal slope forming about one-half the disk, with five or six large nodules on the angle which extends from the umbones to the margin, the dorsal portion of this slope is greatly compressed laterally and viewed from the dorsal line is sinuous, made so by the position of the several large folds on this portion of the shell, which alternate and give to the valve margins a wavy character; these folds are of the same number as the large nodules, formed at the same time, and are highly characteristic; umbones prominent, angular, with numerous coarse folds or wrinkles and with numerous small tubercles which give to the shell a very rough appearance, decurved, approximate; ligament thin, long, light-colored, wavy; lunule ovate; cardinal teeth very oblique, trifold in both valves, striate, not very large, the several divisions rather thin; lateral teeth very long, slightly curved, rather thick, striate, especially at the extremity; anterior cicatrices small, deep, distinct; posterior cicatrices confluent, slightly impressed, very iridescent; pallial line well impressed, especially so anteriorly; dorsal cicatrices small, on the margin of the plate which extends from the cardinal to the lateral teeth; cavity of the shell shallow, of the beaks very deep, long, triangular; nacre white, with brownish patches in the region of the beaks.

Large specimens of this species sometimes reach a length of five inches; the characters of the color patches are like those of *Unio melanurus*, with which this form groups. The shell is common in the Ohio, Wabash, White and Blue rivers. The specimen illustrated was collected by Professor Evermann in the Wabash at Terre Haute and is perfect in every detail.

UNIO LINCOLATUS Rafinesque. Plate 30.

Shell triangular in outline, transversely very much compressed, thick, heavy, very thick anteriorly and in the region of the dorsal margin, securiform, smooth; epidermis light straw-colored, smooth, polished, beautifully rayed with interrupted brownish lines, extending in a wide curve anteriorly from beaks to the ventral margin, some broad, others hair-like, the broader lines sometimes formed of a number of spots, close together, which are V-shaped; lines of growth distinct, somewhat raised, crowded anteriorly; dorsal margin very much curved, anterior margin rounded, projecting, excavated somewhat at the beaks; ventral margin rounded; posterior margin acutely angular, regularly curved on its dorsal part to the ligament; anterior umbonal slope rounded, lateral umbonal slope flat; posterior umbonal slope

sharply angulate, flattened or somewhat excavated on its dorsal aspect; umbones triangular, acute, sharp, decurved, separated, sometimes decorticated; ligament short, thick, black; lunule rather large, roundish, black, membranaceous; cardinal teeth short, heavy, very striate, double in the left and single in the right valve; lateral teeth double in both valves, or disposed to be so, short, slightly curved downwards, thick, heavy, striate; anterior cicatrices distinct, irregular, rough; posterior cicatrices distinct, that of the retractor pedis on the tip of the lateral teeth; anterior portion of pallial line well impressed and crenulate; dorsal cicatrices in the center of the cavity of the beaks; cavity of the shell small, of the beaks rather deep and triangular; nacre pearly white, iridescent posteriorly.

Length, two and one-half to three inches; height, two to two and one-fourth inches; width, one inch. The females are a little more swollen than the males and are less acute posteriorly.

This shell has long been known under the name of *Unio securis* Lea, who described it from the Ohio River, in which it is abundant. But Rafinesque had anticipated him in the description of this form, which he also had from the Ohio, on the Falls at Louisville, where it is a most abundant shell. There can be no doubt of the identity of Rafinesque's species with the later described one of Lea, and I do not hesitate to use Rafinesque's name. Not only did Rafinesque place a specimen in the cabinet of Poulson, of Philadelphia, with his name of *lineolatus*, but his original description must convince any fair-minded student that this and no other shell could have been before him when he drew up his account. I quote it in full below, as reprinted by Chenu in the "Coquilles bivalves fluviatiles de la Riviere Ohio," page 17. Rafinesque did not figure this species.

"23. Espèce, *Obliquaria lineolata* (U. *lineolata*). Obliquaire linéolée.

"Test presque arrondi, épais, peu bombé, un peu tronqué postérieurement; épiderme roussâtre, peu ridé, à quelques lignes brunes; nacre blanche. Longueur quatre cinquièmes, diamètre un moitié, axe un tiers de la largeur. Sommets un peu saillants.

"Aux chutes de l'Ohio; largeur environ deux pouces; portion tronquée postérieure, plane, étroite; impressions profondes, rugueuses, lamellaires, courtes, épaisses, carénées, presque droites."

This shell occurs in great numbers at the Falls of the Ohio, being the most abundant *Unio* there; its flat shape allows it to anchor itself in the cracks between the large rocks of the Falls, and it is not swept

therefrom by the floods. It is common throughout the Ohio, and also is found abundantly in the Wabash. It does not appear in the waters of the northern portion of the State, and is not found in small streams. Its station is on sand, gravel and mud bars, but it best loves mud bottoms; here it buries itself deeply, and may be taken in some places, as near Lawrenceburg, by hundreds. The female is more inflated than the male. It can not be mistaken for any other species.

UNIO ELEGANS Lea. Plate 31.

Shell triangular in outline, rather thick, inflated, smooth, carinated, quite thick anteriorly; epidermis olive or brownish, smooth, polished, beautifully radiated, the color lines being either capillary or broad ones made of capillary lines, placed close together, in many specimens arranged in a kind of zigzag manner, thin; lines of growth numerous, raised, often lighter in color than balance of disk, but sometimes darker; dorsal margin very much curved; anterior margin well rounded; ventral margin at first rounded, then emarginate towards the posterior; the posterior margin pointed, acutely biangular, the dorsal portion straight and placed obliquely; anterior umbonal slope very full and much rounded, angular towards the tips; lateral umbonal slope full, slightly sulcate; posterior umbonal slope angular, inflated, on the dorsal aspect nearly flat and but slightly raised near the margin; umbones greatly elevated, triangular, pointed, decurved, approximated, smooth; ligament short, thick, black; lunule short, broad, black, cordate; cardinal teeth double in the left and single in the right valve, short, thick, heavy, striate, erect; lateral teeth rather short, curved, thick, striate near the ends; anterior cicatrices distinct, deep, roughened, placed near the anterior margin; posterior cicatrices well impressed, distinct, that of the retractor pedis at extreme end of lateral teeth; dorsal cicatrices in a row rather more on the cardinal plate than in the cavity of the beaks; pallial cicatrix well impressed anteriorly, and slightly crenulated; cavity of the shell small, wide, triangular; of the beaks rather large, full, rounded; nacre white, iridescent posteriorly.

Length, two to three inches; height, from one and three-fourths to two inches; width, about one and one-half inches. The females are a little more inflated than the males; they are also more produced posteriorly.

This shell is one of the most beautiful of fresh-water forms, and is usually brilliantly colored. It is abundant in the Ohio, Wabash and White rivers; it also occurs in the Kankakee and other streams in the northwestern parts of the State, but not in the perfection that is seen

in the other streams named. The largest and most beautiful examples which I have ever seen are from the Wabash, where the shell is rarely ever eroded. The zigzag character of the color rays and their capillary nature add to the beauty of the shell.

UNIO DONACIFORMIS Lea. Plate 23, figs. 5-7.

Shell small, thick, very thick anteriorly and in the region of the beaks, ovately triangular in outline, smooth, subinflated laterally, pointed posteriorly; epidermis light straw-yellow to greenish, thin, polished, smooth, beautifully rayed with dark green, the rays departing from the umbones and covering the entire disk, often zigzag, the coloring being disposed as W's or as M's, but commonly in broad bands; lines of growth inconspicuous, darker, raised anteriorly and crowded; dorsal margin curved; anterior margin rounded, making a marked angle with the dorsal margin, posterior margin pointed, biangulate occasionally; ventral margin very much rounded, long; anterior umbonal slope rounded, full; lateral umbonal slope full, subinflated, especially in the female; posterior umbonal slope compressed, angular, flattened near the dorsal margin, sometimes faintly carinate, and with very minute folds; umbones elevated, angular, pointed, decurved, touching, the posterior portion developed into a carina; ligament short, thick, dark or light brown; lunule variable, large in some and small in other specimens; cardinal teeth small, erect, flattened or plate-like, double in the left and single in the right valve, crenate; lateral teeth rather long, thin, plate-like, generally quite straight; anterior cicatrices distinct, well impressed, small; posterior cicatrices distinct, well impressed, the retractor pedis on the tip of the lateral teeth; dorsal cicatrices small, pit-like, in the center of the cavity of the beaks; pallial line faint throughout; cavity of shell wide, small, of the beaks shallow, rounded; nacre white, iridescent posteriorly.

Length, one and one-half inches to two inches; height, one and one-fourth inches; width, three-fourths of an inch, in the female, somewhat less in large males.

Mr. Lea, who described this shell, gave it another name two years after, when, in describing some supposed new forms, he found this shell in the lot. To it he then gave the name of *Unio zigzag*, in allusion to the peculiar markings of the rays. Their identity is now regarded as perfect. This little shell is found in the Ohio, the Wabash and the White rivers, on the gravel bars, crawling actively about. It is very common in all three streams. The larger specimens come from muddy stations and are scarcely eroded when taken from such situations. The shell belongs to the same group as *Unio elegans*, and has

many features in common with that form. The Wabash furnishes the most beautiful examples known. The specific name was bestowed in allusion to its remarkable resemblance to the marine genus *Donax*.

UNIO TRIANGULARIS Barnes. Plate 32.

Shell of medium size, thick, thicker before, smooth, inflated, somewhat triangular in outline, truncated posteriorly; epidermis light yellowish or straw-colored, thin, striate at the ventral and anterior margins, the disk with numerous triangular or arrow-shaped greenish spots, with apex downwards, passing into either broad color lines or into capillary lines towards the ventral margin; lines of growth very distinct, posteriorly impressed, anteriorly raised; dorsal margin curved, anterior margin well rounded, and somewhat produced, ventral margin well rounded, posterior margin oblique and straight in the female, slightly rounded in the male; umbonal slope anteriorly rounded; lateral umbonal slope inflated; posterior umbonal slope inflated very greatly, especially in the female, truncate, flattened from above, with the lines of growth forming imbrications, these imbrications, especially in the female, being dentate, these dentations visible as small and wavy grooves over the entire surface of the upper portion of the posterior slope; the slope is also lighter colored than the balance of the shell and scarcely rayed; umbones very large, prominent, smooth, rounded or faintly angular, very light in color, almost white, decurved, tips not touching; ligament very short, thick, light brown; lunule large, rather long; cardinal teeth double in both valves, erect, thin and plate-like, somewhat curved, serrated; lateral teeth very short, rather thick, striate, the lower one seeming to start well in towards the cavity of the beaks; anterior cicatrices distinct, deeply impressed; posterior cicatrices distinct, slightly impressed, that of the retractor pedis on the tip of the lateral plate; dorsal cicatrices numerous, small, on the plate of the cardinal tooth; pallial line deeply impressed anteriorly; cavity of the shell large, wide, of the beaks wide and subtriangular; nacre white, iridescent on the posterior border.

Length, two and one-fourth to two and three-fourths of an inch; height, one and three-eighths inches; width of female across the posterior slope, nearly one and three-fourths inches; the male is less.

This most beautiful shell is abundant in the White and Wabash rivers; it is also found in the Ohio, but rather rarely.

Dr. Lea described it under the name of *Unio formosus*, from the Ohio River at Cincinnati, in 1831, but his name long since passed into synonymy. The finest specimens which have passed through my

hand in the past twenty-five years came from the White River, near Indianapolis. They are brilliantly colored and absolutely perfect on the apex, showing all the characters of that important region. The shell belongs to a large and well-defined group, of which Lea's *Unio arcæformis* has been regarded the leading form.

The only Indiana shell with which this form can be confounded is the *Margaritana marginata* Barnes, but that shell lacks the lateral teeth, and has, besides, rough folds on the beaks; these characters will alone distinguish them.

Mr. Barnes originally described this species from the Detroit River, Michigan. His description was as follows:

"Shell moderately thick, acutely angulated before, obtuse and somewhat angulated behind; disks inflated; anterior slope flattened and forming a right angle with the disk, ribbed longitudinally and wrinkled transversely; beaks one-third from the posterior extremity, decorticated, approximate and somewhat elevated; anterior lunule oval heart-shaped; posterior lunule not distinct; basal margin a little depressed near the anterior extremity; anterior margin straight, and its edge not entire; epidermis yellowish green, rayed with dark green, finely striated transversely, and with from three to six more conspicuous transverse wrinkles. Anterior slope marked with longitudinal ribs which are beautifully cancellated by the striæ and wrinkles passing over them, ribs projecting and forming a dentated edge; shell slightly gaping at both extremities; cardinal teeth two in each valve, compressed and crenulate, lamellar teeth short, projecting, finely crenulate, and terminating abruptly; nacre bluish white iridescent." (American Journal of Science, Vol. VI, page 273, Plate XV, Fig. 17, 1823.) I think that this well-known shell, described in 1823, should form the type member of the large group to which it belongs, and not *Unio arcæformis* Lea, as above suggested.

UNIO PERSONATUS Say. Plate 33.

Shell circular in outline, inflated, rather thick, thicker before, smooth, small; epidermis dark horn-color, thin, the entire posterior half covered with fine capillary lines which pass from the beaks to the ventro-posterior margin, polished, decorticated on the beaks; lines of growth well marked, numerous, darker, crowded anteriorly, with a tendency to become imbricated on the posterior portion; dorsal margin curved, anterior rounded or obtusely angular; ventral margin round, with slight sinus near the posterior end; posterior margin truncated, emarginate, thin, sometimes dentate, gaping; anterior umbonal slope rounded; lateral umbonal slope subinflated; posterior

umbonal slope swollen in the female, very closely rayed with capillary lines, the lines of growth denticulate, giving a cancellated appearance to a considerable portion; umbones full, rounded, smooth, much elevated above the dorsal margin, decorticated; ligament short, thick, light brown in color; lunule small, wide; cardinal teeth short, thick, solid, double in the left and disposed to be trifid in the right valve, striated; lateral teeth short, thick, curved upwards, striate; anterior cicatrices distinct, small, deeply impressed; posterior cicatrices confluent, large, not deeply impressed; dorsal cicatrices not well marked; pallial line very faintly impressed; cavity of the shell wide, rather large, of the beaks full, round, fairly deep; nacre pure white, iridescent posteriorly.

Length, one and one-half inches to two inches; height, one and five-eighths inches; width, one and one-eighth inches.

This description is based upon a specimen now in the State collection at Indianapolis, which came from the Wabash River, but was received by the State from the Museum of Comparative Zoology, at Cambridge. It is now a very rare shell; indeed, in all the collecting which I have done in Indiana I never found a specimen. It also occurs in the Ohio, but I can give no facts in the matter of its habits.

Mr. Lea described this same species, having the male before him, after Say described it, giving it the name of *Unio capillaris*, in allusion to the fine capillary rays which cover the posterior portions. His specimens came from the Ohio. There are larger specimens in the Call Collection, at Harvard, which were labelled by Say, and still have, or had when the collection was transmitted, his original label. They were secured from Dr. J. Berrien Lindsley, of Nashville, Tennessee, who had them from Dr. Troost, one-time a resident of New Harmony, afterwards State Geologist of Tennessee. It is to be hoped that the species will be rediscovered in the State. It is a member of the *sulcatus* group.

UNIO PERPLEXUS, Lea. Plate 34.

Shell rather large, lenticular, thick, thicker anteriorly, usually smooth, occasionally with two or three low and depressed bosses on the posterior slope, sometimes with hints of very low tubercles on the lateral slope, striate near the margins, sulcate on both posterior slopes; epidermis very light yellow or straw-color, with numerous capillary rays over the whole disk, but especially numerous near the posterior end, wavy, sometimes joined together to form a broad green line from the beaks to the margin; lines of growth not close, darker, raised, giving the shell a slightly roughened appearance, very light-colored

on the umbones, thin; dorsal margin slightly curved; anterior margin well rounded; ventral margin rounded anteriorly, emarginate posteriorly where the sulcus of the disk reaches it; biangular posteriorly, and curved; anterior umbonal slope rounded, lateral umbonal slope with distant low swellings or low bosses, indicative of tubercles; posterior slope flattened, subangulate, lighter colored; umbones small, rather full, somewhat raised above the dorsal margin, decurved, approximate, smooth, light-colored; ligament short, thick, light brown; lunule small, black; cardinal teeth small, short, thick, erect, double in the left and disposed to be double in the right valve; if double in the right valve then the anterior portion is much the smaller, roughened; lateral teeth rather long, slightly curved, thick, strong, striate; anterior cicatrices distinct, deeply impressed; posterior cicatrices well impressed, confluent, that of the retractor pedis muscle on the tip of the lateral tooth; pallial line faintly impressed; dorsal cicatrices small, in the center of the cavity of the beaks; cavity of shell rather small, of the beaks wide and shallow; nacre pure white, scarcely iridescent.

Length, two to two and one-half inches; height, one and one-fourth to one and one-half inches; width, three-fourths of an inch. The female is quite different in outline, the ventral margin being decurved and not emarginate, while the whole posterior slope is wider and far more inflated. That portion of the disk is often rough and lumpy in the female form.

This species is abundant in the White, Ohio, Wabash and Eel rivers, in all of which it has been personally collected. The shell is very variable; but all the main specific characters seem quite constant. Mr. Lea described this same shell from two Indiana localities, giving it other names, as follows: *Unio sampsonii*, with the bosses of our description much more developed, and *Unio rangianus*, which is a very sulcate male form. The species described first must, of course, have priority; from it the whole group, which is very extensive, takes its name. Members of this group occur as far south as Alabama and have a variety of names which have elsewhere been indicated.*

UNIO SULCATUS Lea. Plate 35.

Shell small, subquadrate, inflated, smooth, rather thick, a little longer than high in the female; epidermis thin, usually light yellowish in color, sometimes olive-green polished, striate at margins, with numerous dark-green capillary rays over the whole disk, light-colored on the umbones; lines of growth distinctly impressed, imbricated

*See A Geographic Catalogue of the Unionida of the Mississippi Valley, Bulletin Des Moines Academy of Science, Vol. I, No. 1, pp. 41, 42, 1885.

posteriorly and denticulate in the female; dorsal margin somewhat curved, oblique anteriorly; anterior margin rounded; posterior margin emarginate denticulate, the teeth fitting into interspaces on opposite valve, but only so in the female, the male being without denticulations; anterior umbonal slope full and round, lateral umbonal slope subinflated, posterior umbonal slope sulcate, inflated and especially so towards the ventral margins, the lower division usually projecting farthest, denticulate, with numerous imbricated older denticulations over the marginal third left from former margins, which give a cancellated appearance to some specimens, a narrow groove or sulcus extending from two-thirds of the disk to the margin, the groove dividing the posterior inflation so that the lower division is the more swollen; the posterior dorsal margin is depressed; umbones small, full, rounded, decurved, not touching, lighter colored; ligament short, narrow, thick, light brown; lunule short, wide, membranaceous, oval; cardinal teeth short, thick, erect, slightly curved anteriorly, double in the left valve and disposed to be trifid in the right valve, irregular, triangular; lateral teeth short, thick, straight, crenately striate; anterior cicatrices small, very deeply impressed, distinct; posterior cicatrices distinct, large, very deeply impressed, the small retractor pedis at tip of the laterals and pit-like; dorsal cicatrices very small, in the center of the cavity of the beaks; pallial cicatrix faintly impressed; cavity of the shell small, rather wide; of the beaks shallow; nacre pearly white, iridescent posteriorly.

Length, one and one-fourth inches; height, one inch; width, three-fourths of an inch.

This description is based solely on two females, the male not being at hand when it was made, though it was afterwards received for figuring. In the male the shell is less rotund, and the emargination is wanting, as well as the posterior denticulations. The male is much longer and much flatter. Accompanying the two that are described was a male specimen of *Unio rangianus* (= *Unio perpléxus* Lea), and my experience has been that these are often confused.

This beautiful little shell is found in the Wabash and the Ohio, and less commonly in the White River; the specimens described came from the last named. The very large circular shape of the posterior adductor impression is unlike anything presented by another Indiana shell, and will help to separate it. The species is usually regarded as being rare.

UNIO LUTEOLUS Lamarck. Plate 36.

Shell large, elongate, somewhat inflated, rather thin, circularly rounded before, elliptically rounded behind, the male often somewhat pointed posteriorly, female more tumid posteriorly, emarginate ventrally; epidermis light horn-color, polished and shining, usually abundantly rayed with narrow, bright, green, crenulate, somewhat curved rays, which depart from the beaks and cover more or less closely the posterior three-fourths of the disk; these are often wanting, especially in old specimens; lunule long, narrow; ligament long, thin, light horn-color; hinge margin nearly straight or very slightly arcuate; umbones prominent, approximate, concentrically wrinkled, the wrinkles being angulate and the apices of each pointing toward apex of the umbone, light, nearly white, in color, when the epidermis is perfect; cardinal teeth double in both valves, equal only in the left valve, rather small, thin, acutely serrate, all directed anteriorly; lateral teeth long, thin, lamellar, striate, nearly or quite straight; dorsal plate smooth, short, rounded, thin; anterior cicatrices distinct, that of the adductor rather deep, large, striate, irregularly impressed, that of the protractor pedis well impressed but not deep; posterior cicatrices confluent, very slightly impressed. smooth, iridescent; pallial cicatrix well impressed before, broad and shallow, or scarcely impressed, behind; dorsal cicatrices numerous, impressed as deep pits in an irregular row in the center of the cavity of the beaks; cavity of the beaks rather shallow; nacre pure white, sometimes somewhat iridescent posteriorly.

This form is widely distributed throughout the central west, and is not only abundant but is frequently the only form found. It is usually of a darker color when it inhabits muddy river beds. The females are the most numerous and the most variable in outline, which fact accounts for their use in the several descriptions of shells that now form synonyms of this species. Mr. Barnes has described the large and swollen female, such as is often found in the Wabash and the Ohio, under the name of *Unio siliquoideus*.

The original description of Lamarck was as follows:

“*U. testa oblongo-ovata, tenui subpellucida, luteo-virente, radiata; latere antico majore, latiore, rotundato.*

“*Habite la riviere Susquehana et celle Mohancks, dans les Etats Unis.*
* * * *La ligament passe entre le crochet et la charniere. Largeur, 69 millimetres.*”

This short and imperfect description was not known to the earlier students of American mollusca, and there is little wonder that considerable synonymy has been established on this shell. It has a very wide range, extending from Winnipeg and Slave lakes and the Sas-

katchewan River, British America, to central New York, south to Georgia, Alabama, Texas; west to Kansas, Montana and Dakota. In all this range it is abundant in favorable localities and often attains a great size. Lamarck's original specimens did not approach the maximum dimensions which this shell sometimes reaches.

A very beautiful and somewhat depauperate form occurs in the lakes of northern Indiana. It was a specimen of this sort that constituted the basis of Anthony's description of *Unio distans*. Though sometimes confounded with *Unio ligamentinus* Lamarck, there is really no excuse for the confusion of the two forms, since they are more dissimilar than alike.

The character of the undulations on the beaks of this form will serve to separate it from all others. It is often confused with *Unio ligamentinus*, as suggested above, but the beaks alone will serve to distinguish them.

UNIO MULTIRADIATUS Lea. Plate 37.

Shell subrotundate, rather thick, slightly thicker anteriorly, smooth, compressed laterally, medium in size; epidermis thin, light straw-color. lighter on the umbones, brilliantly rayed with green rays, many of which are capillary, extending from the middle of the first-formed shell to the ventral margin, the lines wavy, interrupted at the lines of growth, sometimes broader by the union of several capillary rays; lines of growth numerous, raised; dorsal margin curved, anterior margin produced, rounded; ventral margin well rounded, posterior margin subbiangulate, in females emarginate, pointed somewhat in the male; anterior umbonal slope flattened, lateral umbonal slope rounded, posterior umbonal slope inflated, somewhat angulated near the beaks, especially in the male; covered with minute capillary rays; umbones depressed, full, rounded, decurved, approximate, light-colored, with several fine undulations which are indistinct; ligament large, short, high, thick, dark reddish horn-color; lunule long, linear, membranaceous; cardinal teeth double in the left valve and disposed to be double in the right, specimens varying in this particular, short, thick, erect, the posterior division being the larger, triangular; lateral teeth short, rather thick, striate, curved; anterior cicatrices large, well impressed, distinct; posterior cicatrices confluent, large, slightly impressed; dorsal cicatrices in the center of the cavity of the beaks; cavity of the shell large, inflated, of the beaks rounded, excavated, subtriangular; nacre white and beautifully iridescent posteriorly, so thin near the posterior margins that the color lines or rays show through without transmitted light.

Length, two and one-half to three inches; height, one and one-half to two inches; width, one inch, the female sometimes larger.

The specimens described came from the Wabash River, in which stream it is an abundant species. It is also found in some of the small lakes in northern Indiana, in the Ohio, and in the White rivers. Fine, but rare, examples were obtained in 1896 in the Eel River, near North Manchester. It has been received from various people under the names of *Unio ligamentinus* Lamarck and *Unio ventricosus* Barnes, but is easily distinguished by the characters of the rays alone. It is usually an abundant shell.

UNIO VENTRICOSUS Barnes. Plate 38.

Shell large, rather thin, ventricose, smooth, subelliptical in outline; epidermis thin, polished, smooth, striate near the margins occasionally but rarely, with numerous broad and green rays extending to the ventral margin from the middle of the umbonal slope, light straw-colored, lighter on the beaks; lines of growth widely separated, well impressed, darker, interrupting the rays; dorsal margin well curved; anterior margin well rounded, projecting; ventral margin slightly curved; posterior margin inclined to be emarginate in the female, pointed in the male, subangular; anterior umbonal slope well rounded, full, swollen; posterior umbonal slope full, subangular, with many green rays which makes this slope the darkest portion of the shell; lateral slope rounded; umbones large, full, decurved, triangular, with three or four coarse undulations near the apex, lighter colored than balance of the shell, approximating; ligament large, short, thick, powerful, dark reddish or horn-color, much raised above the dorsal margin; lunule small, dark; cardinal teeth short, erect, thin and plate-like, sometimes more thickened, double in the left and single in the right valve, serrate; lateral teeth fairly long, curved, plate-like, striate; anterior cicatrices large, distinct, deeply impressed, concentrically striate; posterior cicatrices not at all impressed, confluent; dorsal cicatrices on the cardinal plate small; pallial line hardly impressed; cavity of the shell very large, of the beaks large, rounded, deeply excavated into the umbones; nacre pure white, iridescent posteriorly.

Length, three to four or five inches; height, three inches; width, one and one-half to two inches, varying with the sex.

Unio ventricosus is one of the most common shells in Indiana, and has been found in nearly every part of the State. Large and fine examples have come from the Ohio, the Wabash, the Eel and the Kankakee. It is a variable shell, and this may be the reason why it has had so many names given it by descriptive naturalists. Mr. Lea de-

scribed a beautifully rayed and polished form from the Ohio under the name of *Unio occidens*; from Canada he described a similar shell under the name of *Unio canadensis*, and from other localities still other forms came in for names. But Mr. Barnes first described the shell, and his name must stand for it. It can not be well confounded with any other species; its beaks alone will serve to separate it from all other Indiana shells; its nearest congener is the following, but the umbones of *ventricosus* are rounded, of *subovatus* quite angular. The specimen described and figured herein is from the Mankato River.

UNIO SUBOVATUS Say. Plate 39.

Shell very large, rather thick, thicker anteriorly, ovate in outline, smooth, ventricose, greatly compressed on the posterior dorsal margin, gaping; epidermis yellowish straw-color, thin, smooth, polished, radiate, darker on the posterior umbonal slope, where it is not only striate but the epidermis is often modified into a kind of short, brown wool which is especially marked near the margin; lines of growth distant, coarse, crowded anteriorly, more or less irregular; dorsal margin greatly curved, thickened, anterior margin full and round; posterior margin widely rounded, somewhat emarginate in the female, but inclined to be pointed in the male; ventral margin long, slightly curved; anterior umbonal slope full, large, round, somewhat excavated in the region of the beaks; posterior umbonal slope very much inflated, angular, very flat near the beaks, darker, much roughened; lateral umbonal slope full, polished; umbones very much raised, triangular, full, angulate, usually decorticated, separated, decurved, lighter colored; ligament short, wide, very thick and powerful, dark horn-color or brown, much raised above the dorsal margin and sometimes higher than the beaks; lunule none; cardinals short, thick, but not remarkably so, double in both valves, serrate, crenate; laterals short, thick, not much elevated, striate, slightly curved; anterior cicatrices very large, deeply impressed, irregular in outline; posterior cicatrices not at all impressed, confluent, concentrically striate, iridescent; anterior portion of the pallial line crenately impressed; dorsal cicatrices numerous, large, in a row on the plate of the cardinal tooth; cavity of the shell very large, wide, deep; of the beaks very deeply excavated, full, triangularly rounded; nacre pearly white, iridescent posteriorly.

Length, four and one-half to six inches, the last being that of the more pointed males; height, three and one-half to four inches; width of females, from two and one-fourth to two and one-half inches. Larger specimens sometimes occur.

This species is one of the largest that are found in American waters. It is often confused with *Unio ventricosus* Barnes, but may easily be distinguished by the characters of the posterior slope and of the beaks; it also attains a much greater size than Barnes's form. The specimen figured and described herein is a female, from the Wabash, and belongs to the State collection. The species occurs also in the White and Ohio rivers, somewhat abundantly, and rarely in the Eel River, near North Manchester. No other large *Unio* in Indiana has so peculiarly angulated a posterior slope.

UNIO CAPAX Green. Plate 40.

Shell large, rather thick, very ventricose, higher and inflated posteriorly, circularly oval in outline, viewed posteriorly shaped like the marine *Cardium*; epidermis dark drab to brownish, lighter on the beaks, smooth, polished, eradiate, or faintly rayed with darker brown rays especially on the dorsal portion of the posterior umbonal slope, striate near the margins; lines of growth coarse, numerous, somewhat raised, lighter colored; dorsal margin very much curved, even sinuous; anterior margin somewhat angulated, produced, about one-half as long as the posterior margin; the posterior margin roundly angulated, very long, sometimes emarginate in the female, much elevated above the laterals, ventral margin straight; the umbonal slopes all very much inflated, very large, all rounded, that of the anterior portion excavated under the beaks, the female is especially inflated in this region; umbones very large, very much raised, rounded, curved, touching, as the shell gets old the beaks wear each other away, viewed from either the anterior or posterior the outline is very much like that of *Cardium*; ligament large, thick, coarse, dark brown, raised; lunule large, black, elliptical; cardinal teeth single in the left and double in the right valve, depressed, thick plate-like, very serrate; lateral teeth rather short, thin, striate, curved, double in the left and single in the right valve; anterior cicatrices very large, deep, that of the adductor deeply impressed quite near the margin; posterior cicatrices very large, slightly impressed, very iridescent; pallial line deeply impressed anteriorly, iridescent throughout; dorsal cicatrices numerous, large, in a row on the cardinal plate; cavity of the shell very large, deep, broad; of the beaks very wide, deep, round, excavated into the decurved portion; nacre pure white, somewhat iridescent posteriorly.

This description is based upon a single large female, which measures four and one-half inches in length; three and one-fourth inches in height; two and three-fourths inches in width. The specimen came from the Wabash.

This is by no means a common shell in Indiana, and is only known from the two large streams, the Ohio and the Wabash. Its greatly swollen character will enable it to be easily separated from all other shells.

UNIO LIGAMENTINUS Lamarck. Plate 41.

This, one of the oldest and best known Unios, was described from the Ohio River by Lamarck, *Animaux sans Vertebres*, edition of 1838, Vol. VI, page 533, as follows:

“*U. testa ovali tumida, sub epiderme candida; ligamento subduplici: unico externo detecto; allero intra natem et cardinem obfecto.*”

“*Habite la riviere de l'Ohio. A. Michaud. La coquille a sur chaque valve un angle obtus au cote antérieur. Son test est tres blanc. Son corselet est un peu eleve en carène. Dent cardinale fort épaisse. Largeur, 77 millimetres.*”

It is quite possible that the very extensive synonymy that is exhibited by this species is due largely to the incomplete description which Lamarck gave to this form. It is widely distributed over the United States from western New York to Michigan, Minnesota, Dakota, and Kansas; south to Texas, Louisiana, Alabama, and Tennessee. In this vast range, throughout which it is common or abundant, it has a wonderfully diversified environment. Its home may be in sluggish and muddy bayous, where it delights to dwell in mud and sand; in rapidly flowing mountain streams, like the upper Cumberland and the Holston rivers, where it may be found on gravel bars or wedged in between the larger rocks in the middle of the channels; in the muddy or gravelly rivers of the western prairie States, as in Iowa and Illinois, where it dwells indifferently in mud or gravel. It follows, therefore, that these great differences in environment will be influential in determining its coloration and its form. So it is among the most variable, in minor details, of any of the common river-mussels of the western States, sharing in this regard the changes in form incident to *Unio luteolus* Lamarck and *Unio complanatus* Solander, the last named being a form which has never yet been found in any stream west of the Appalachians, outside the drainage of the Great Lakes. These very variable shells have been described many times by those who look for differences rather than resemblances, and so the great burden of synonymy has arisen.

Shell large, elliptical, compressed, rounded before, subbiangulate behind, smooth or striate, thickened anteriorly, thin and iridescent posteriorly; epidermis yellowish straw-color, rayed with numerous,

broad, green rays, extending from the umbones ventrad; the rays are indistinct or wanting anteriorly; lines of growth numerous and often, especially in old specimens, raised into ridges which are concentric with the ventral margin; ligament long, thick, black, nearly straight; umbones scarcely prominent approximating, with many very fine, concentric folds, apparent only in young specimens with perfect epidermis; from the posterior edge of the umbones an obtuse angle extends over the disk posteriorly to the margin where it is apparent at one of the angles which renders the outline biangulate; cardinal teeth double in the left, and disposed to be double in the right valve, triangular, crenulate, roughened; lateral teeth long, lamellar, slightly curved ventrad, crenulate; plate between cardinal and lateral teeth incrassate, arched, smooth; anterior cicatrices large, deeply impressed, distinct; posterior cicatrices large, slightly impressed, confluent, that of the retractor pedis muscle impressed at the extreme end of the lateral teeth; dorsal cicatrices in the cavity of the umbones as deep pits disposed in a straight line, which ends near the margin of the plate; pallial cicatrix crenulate, deeply impressed anteriorly; nacre pure white, iridescent, in many specimens with a blush of pink or with decided pink coloration.

Length, 125 mm.; height, 75 mm.; breadth, 52 mm.

The measurements given are those of a large specimen from the Des Moines River, at Des Moines, Iowa. The species often exceeds these dimensions, but is commonly found smaller. In the female the posterior margin is much more rounded than in the male, and the biangulate character quite disappears. The general outline is more flowingly rounded, and the transverse measurements somewhat greater, in the female than in the male shell.

Say's description of *Unio crassus*, which is a synonym, does not agree with his figure, as has already been pointed out by Dr. Lea. He says his species has waves, while the figure, which shows the interior of the shell only, does not give any hint of that character. It is doubtful that the description and figure were made from the same species. Moreover, it will be noticed, from the dates assigned to these several forms in their synonymy, that Say's species was described long before Lamarck framed his description. But there had already been described from Europe, by Retzius, 1788, a species with the name Say employed. Say's name, therefore, falls into synonymy. This shell is often received from correspondents under the name of *Unio luteolus* Lamarck, which form it very closely, in some respects, resembles.

This species is very abundant all over Indiana, and especially so in the Ohio, Wabash and Kankakee. It is a mud-loving species and

may commonly be found in association with *Unio luteolus*, *Unio multiplicatus* and *Unio undulatus*. It is easily identified; from related forms like *Unio ventricosus* the beaks will separate it.

UNIO COOPERIANI'S Lea. Plate 42.

Shell circular in outline, large, very thick, nodulate, laterally compressed; epidermis dark brown, striate, somewhat polished on the umbones, radiate, lighter in color on the posterior slope, rather thick; lines of growth numerous, raised, darker, somewhat inclined to be imbricated on the posterior slope, dorsal margin curved, anterior margin somewhat angulate; ventral margin roundly curved; posterior margin rounded, with a tendency to be biangulate; anterior umbonal slope round and full, with a few very small folds just anterior to the beaks; lateral umbonal slope rounded, with a number of large nodules or pustules on its middle portion; posterior umbonal slope compressed, with scattered nodules which are not very large, near the dorsal margin the nodules are very small and arranged more or less definitely in rows which extend to the dorsal margin; umbones full, fairly prominent, eroded, dark colored when perfect; ligament short, thick, wide, very dark brown; lunule elliptical, almost black, membranaceous; cardinals double in the left and single in the right valve, short, erect, thick, very much striated, serrate; lateral teeth short, thick, straight, striate; anterior cicatrices large, deeply impressed, distinct; posterior cicatrices distinct, deeply impressed, concentrically striate; pallial cicatrix very crenate anteriorly, scarcely visible posteriorly; dorsal cicatrices on the cardinal plate; cavity of the shell narrow, of the beaks deep, triangular, narrow; nacre very white and iridescent.

This shell often attains a length of four inches, and is quite three inches in height. The females are sometimes inclined to be emarginate, and are more convex than the males. It is a common shell in the Ohio and the Wabash, but has been noticed by me in no other Indiana streams. It is commonly mistaken for *Unio pustulosus* Lea, from which it differs in the color and markings of the epidermis, the number, character and disposition of the nodules, the characters of the hinge teeth and in general outline; nevertheless it often is seen with specimens of that form under a common label.

UNIO IRRORATUS Lea. Plate 43.

Shell small, thick, convex, round or circular, very thick anteriorly and in the region of the beaks, nodulate; epidermis light yellow, thin, lighter on the beaks, beautifully and densely rayed with bright green capillary rays over the whole disk, the rays being sometimes made up

of a succession of linear green spots, sometimes the capillary lines are so crowded together that they form either a broad ray or cover a large portion of the disk with green, shining; lines of growth very much impressed, giving the shells a roughened appearance, interrupting the rays; dorsal margin greatly curved; anterior margin scarcely produced, nearly straight; ventral margin long, greatly rounded; posterior margin biangulately rounded, emarginate in female, produced in the male; umbonal slope convex, full rounded; the lateral slope either flattened or somewhat sulcate, with many large and small nodules arranged without definite order; posterior slope subangulate, sometimes markedly so, the angle extending from the umbones to the margin, the dorsal portion having numerous linear and curved lines of folds which extend to its margin; umbones very much raised, triangular, pointed, decurved, approximating, apiculate in the young, angulated; ligament short, thick, black; lunule heart-shaped, very well marked, black; cardinal teeth short, very thick, very rough, serrate; lateral teeth short, very wide and thick, coarsely striate, slightly curved; anterior cicatrices distinct, very deeply impressed, that of the anterior retractor pedis as a pit in the lower portion of the anterior division of the cardinal teeth; posterior cicatrices distinct, well impressed, that of the retractor pedis deep, as a pit at the end of the lateral; pallial cicatrix well impressed, especially anteriorly; dorsal cicatrices very small, on the cardinal plate; cavity of the shell small, narrow; of the beaks broadly triangular; nacre silvery white, occasional specimens being found with a tinge of salmon.

Specimens have been seen which were from two and one-half to three inches in both length and height, these two dimensions being nearly equal. Width, from one and one-fourth to one and one-half inches, depending on the sex. Shell common.

Numerous specimens may be taken in the White, the Wabash and the Ohio. The general green appearance of the shell and its circular outline, with its nodules, will enable any one to separate it from all others. The Wabash specimens are especially fine since the beaks are rarely ever eroded when taken from that stream.

UNIO PUSTULATUS Lea. Plate 44.

Shell subquadrate in outline, thick, thicker before, nearly as high as long, pustulate, inflated; epidermis thin, polished on the umbones, striate elsewhere, dark horn-color, sometimes greenish yellow, the pustules much lighter in color; lines of growth conspicuous, far apart, darker, concentric; dorsal margin straight behind the umbones, rounded before; anterior margin well rounded; ventral margin

rounded, sometimes emarginate; posterior margin truncate, straight, forming a right angle with the dorsal margin; anterior umbonal slope rounded; lateral umbonal slope full, rounded, with three to five large pustules arranged in a row from the beaks to the margin, and another row of large pustules on the border line of the posterior slope which is flattened, raised to the margin on the dorsal aspect, and has a number of small pustules crowded together, without order, on the slope; umbones rather full, rounded, decurved, with a few coarse wrinkles or folds; ligament short, thick, narrow, dark-brown; lunule conspicuous, small, black; cardinals large, thick, heavy, double in the left and single in the right valve crenulate; lateral teeth short, straight, lamellar, forming a right angle with the plate of the cardinal tooth; anterior cicatrices distinct, deeply impressed; posterior cicatrices confluent, slightly impressed, concentrically striate and very iridescent; dorsal cicatrices in the center of the cavity of the beaks; pallial cicatrix very much crenulated anteriorly; cavity of the shell small, of the beaks triangularly-rounded; nacre dead white.

This shell is often mistaken for the following one, but is entirely different in the number, kind and arrangement of the pustules; the characters of the teeth differ also. In the present species the large tubercles are arranged in two rows from the beaks to the ventral margin; they often are partially formed, as in the specimen figured, on the ventral margin and are then seen to be produced by a fold of the mantle, the animal appearing to be too large for its shell and thus forming the pustules which are, at first, simply folds in the margin of the shell; afterwards the mantle completely fills the under side with nacre, thus lifting the fold into prominence as a pustule. The outline of the shell is different from that of *pustulosus* with which it is often confused. In both species, in the young, rather large, quadrate, green spots appear on the umbones and the upper portions of the lateral umbonal slope; these are highly characteristic.

Unio pustulatus occurs in the Ohio, Wabash, White, Blue, Eel and Kankakee rivers, and is a fairly common shell. It is to be found in muddy bottoms and in still waters; poor specimens may be taken, as at the Falls of the Ohio, on gravel beds.

UNIO PUSTULOSUS Lea. Plates 45, 46, 47.

Shell large, thick, heavy, pustulate, rounded in outline, ventricose; epidermis striate, especially so towards the margins, yellowish green in color, thin, with numerous fairly large green spots on the umbonal slope, especially above the region where the pustules begin; lines of growth numerous, impressed, imbricated posteriorly, darker in the

middle umbonal region; dorsal margin nearly straight, anterior margin forming an obtuse angle with it; anterior margin nearly straight, ventral margin rounded, posterior margin produced, slightly biangulate, sometimes emarginate; umbonal slopes all rounded and full, the superior portion of the posterior slope being covered with minute pustules, and being somewhat sulcate; umbones full, elevated, round, free from pustules, separated, greenish colored or with large spots of green; ligament long, thick, wide, dark brown color; lunule large, ovate, membranaceous; cardinal teeth large, heavy, short, striate, rough, double in the left valve and single in the right valve; lateral teeth thick, heavy, straight, crenately striate; anterior cicatrices deep, distinct, rough; posterior cicatrices distinct, deeply impressed; pallial line crenate, well impressed; dorsal cicatrices on the cardinal plate, small, numerous; cavity of shell shallow, of the beaks deep and triangular; nacre white, with occasional blotches of brownish color.

The shell which forms the basis of this description is a fair type of the form which Dr. Lea called *Unio dorfeuillianus*, from the Ohio River. It is a large example of typical *pustulosus*, which name will, properly, include many which Dr. Lea has given this shell from other localities. In Indiana the species occurs very abundantly in the Ohio and Wabash rivers, and in the White and Eel rivers, but in the two last named it is not as large a shell as in the Ohio River. It dwells in muddy bottoms, but is quite active, and may always be taken crawling around on sand and gravel bars, especially when the rivers are receding from floods. The species as seen in the Wabash and Ohio presents very constant features, but in the White and Eel rivers it is a flatter shell than is indicated in the above description.

UNIO GRANIFERUS Lea.

Shell circular in outline, inflated, thick, heavy, very thick anteriorly and in the region of the umbones, pustulate, the knobs being rather sharp and most numerous over the lateral umbonal slope; epidermis chocolate brown, shining on the umbonal slopes, striate, especially so near the margins, rather thin, eradiate; dorsal margin nearly straight, anterior and ventral margins well rounded, posterior margin rounded-emarginate, especially emarginate in the female; ligament large, thick, reddish brown, ovate, raised much above the dorsal margin; lunule large, black, membranaceous, oval; anterior umbonal slope abruptly rounded, lateral umbonal slope full, inflated, covered with many small tubercles which are often eroded at the tips; posterior umbonal slope subangulate near the beaks, compressed below, somewhat sulcate, with a number of small tubercles which are rather

pointed and two obtuse carinæ which extend to the siphonal openings; cardinal teeth heavy, thick, erect, much divided, double in the left and disposed to be trifid in the right valve, very striate and serrate on the margins, the cardinal plate massive; lateral teeth short, thin, striated near ends, plate-like, joined to cardinal by a broad plate; anterior cicatrices deep, rough, concentrically striate, distinct, that of the anterior retractor pedis placed well under the lobe of the cardinal tooth; posterior cicatrices deep, distinct, striate concentrically, that of the retractor pedis at tip of the laterals; anterior portion of the pallial line very deeply and crenately impressed; dorsal cicatrices numerous, pit-like, placed on the cardinal plate near its margin; cavity of shell large, of the beaks very deep and roundly triangular; nacre purple or bluish, margined sometimes with white.

This description is based upon Number H1672 of the collections of the American Museum of Natural History, and it is due to the courtesy of Professor Whitfield that the shell could be used for this purpose. The series came from the Mississippi River, at Davenport, and is a most beautiful one.

The close general appearance which this shell presents to *Unio pustulosus*, coupled with its beautiful purplish nacre, will separate it from all Indiana shells except *Unio verrucosus*. The last named shell is, however, much more flat, and the pustules are larger and far more numerous; the character of the beaks is entirely different, those of *verrucosus* being triangular and covered with fine wavy lines. The umbones of this shell are inflated, large, very prominent, apiculate, and directed anteriorly. The two shells need not be confused.

Unio graniferus occurs in the White, Wabash, Blue and Ohio rivers. It is abundant in the Ohio and Wabash where it attains a large size.

UNIO LACHRYMOSUS Lea. Plate 48.

Shell large, thick, heavy, thicker anteriorly and very thick in the region of the beaks; flattened in the young but fairly well inflated in the old specimens, quadrate in outline, sulcate on the disks, tuberculate, especially so on the umbonal slope, the larger tubercles appearing to run down the side of the disk as a thick liquid would flow, a fact which suggests the specific name; epidermis smooth, striate near the margins, dark horn-color, eradiate; lines of growth numerous, crowded near the anterior and other margins, impressed; dorsal margin slightly curved, anterior margin well rounded; ventral margin emarginate towards the posterior end, rounded in front; posterior margin emarginate, somewhat produced; anterior umbonal slope well rounded, full, lateral umbonal slope rounded, or sometimes sulcate, in young speci-

mens much flatter; posterior umbonal slope angular, tuberculate, compressed towards the dorsal margin and with many small tubercles; umbones large, full, triangular, full of small tubercles which are rather sharp and pointed, decurved, not approximating; ligament large, thick, black or dark brown; lunule ovate, large membranaceous; cardinal teeth large, thick, heavy, erect, striate, disposed to be double in both valves; lateral teeth long, slightly curved, striate, thick; anterior cicatrices large, rough, distinct; posterior cicatrices large, confluent, not deep, striate; anterior portion of the pallial line very deeply impressed and crenulate; dorsal cicatrices placed on the plate of the cardinal teeth; cavity of the shell large, of the beaks large, triangular, excavated well up into the beaks; nacre pearly white, iridescent.

This species is very abundant in all the larger streams of southern and northwestern Indiana, and in the Ohio; it is one of the mud-inhabiting shells. The size it attains often reaches four and one-half inches in length, and as much in height. The arrangement of the tubercles is various, no two specimens showing the same order; in some forms the shells are nearly smooth or have only a few large pustules; in others they are very numerous and arranged all over the disk, with a more or less two-lined order for the larger ones. The sulcation of the lateral umbonal slope extends from the beaks quite to the margin, becoming wider as it lengthens. Dr. Lea described his *Unio asperrimus* from a form of this species which had sharper tubercles than usual, with fewer large ones. Closely allied to it, and often mistaken for it, is the next species, specimens of which I have seen from Indiana. Indeed, the State collection at Indianapolis contains *Unio lachrymosus* with the name of Conrad's form; such a specimen was sent to me for figuring as *Unio fragosus*, but is the one used herewith in making the smaller figure illustrating Lea's shell. It remains only to say that this is a most abundant shell in all places where it is found at all. It should be easily separated from all others.

UNIO FRAGOSUS Conrad.

"Shell suborbicular, ventricose, with an indistinct narrow furrow, and two approximate series of very prominent irregular tubercles, anterior ones largest; umbonal slope angular; posterior slope slightly concave, with a few narrow rib-like tubercles, more prominent near the margin; posterior margin direct, slightly emarginate; ligament slope straight, slightly oblique; umbo narrow, prominent, beaks much incurved, pointed, tuberculated; epidermis brown, with two or three broad widely interrupted rays.

"Observations.—This fine species approaches *quadrulus* Raf., but is

much more ventricose, has more prominent tubercles, and is very distinct. I am indebted to Dr. Blanding for the splendid specimen represented by the figure; it is from the Scioto River, Ohio." (Conrad, Monography of the Family Unionidæ, page 12, Plate VI, Fig. 2, 1836.)

I have been unable to secure a specimen of this very common shell for redescription, the shell sent for this species from the State collection being the preceding form. I have, therefore, been obliged to copy Conrad's original description. Many specimens have, however, passed through my hands, from time to time; from these it may be said that the species is a much more ventricose one than *Unio lachrymosus*, it is more quadrate in outline, the posterior slope is much rougher and is commonly imbricated by the growth lines, the color of the young specimen is more green than in the allied form of Lea, and the whole facies of the shell is very much rougher. It does not seem possible that they could be confused. Large and fine specimens are in the Call Collection, at the Museum of Comparative Zoology, at Cambridge, and represent a wide distribution, from Ohio to Kansas. In this State I have seen specimens which came from the Ohio, collected by myself at Charleston, and three fine ones from the Wabash, collected by Dr. Barton W. Evermann. It is to be regretted that one could not be secured for purposes of illustration.

UNIO VERRUCOSUS Barnes. Plate 49.

Shell subcircular, pustulate, large, thick, heavy, ventricose in the young, but far more flattened in the old specimen; epidermis dark horn-color to chocolate color, thick, reddish-brown on the beaks in some specimens, striate, polished on the lateral umbonal slope; lines of growth very numerous, crowded, slightly darker; dorsal margin straight, somewhat decurved anteriorly; anterior margin rounded; ventral margin well rounded; posterior margin rounded, emarginate, oblique; anterior umbonal slope full and round; lateral umbonal slope rounded, with more or less regularly arranged tubercles, some of which are rather sharp; posterior umbonal slope somewhat compressed, pustulate, deeply furrowed from near the umbones to the margin, the furrow causing the emargination, a few small, somewhat regularly arranged pustules on either the angle or near the dorsal margin; umbones full, small, pointed, decurved and directed anteriorly, very finely and crenately plicate, approximate; ligament thick, large, dark brown, very long; lunule large, cordate; cardinal teeth double in the left and disposed to be trifid in the right valve, rough, irregular, striate; lateral teeth short, thick, straight, striate, rough,

often diseased; anterior cicatrices distinct, deep, rough, excavated under the cardinals, which project over the adductor; posterior cicatrices distinct, deeply impressed, concentrically striate; dorsal cicatrices numerous, in a row on the outer side of the cardinal plate not far from its edge; pallial line deeply impressed and crenulated anteriorly; cavity of the shell large, of the beaks large, deep, triangular, extending well up into the beaks; nacre purple or chocolate color.

Specimens of this species sometimes attain a size of five inches in length, and almost an equal height. The specimens on which the foregoing description is based came from the Wabash River. The shell is common in the Ohio and of large size. One of the three specimens before me came from the State collection under the name of *Unio graniferus* Lea, but is not that species; both have purple nacre, but *graniferus* is of the shape of *irroratus*, the pustules are quite different, the shell is far more inflated, and its outline more round than *verrucosus*. This shell is found in the Kankakee, Wabash, White and Ohio rivers; probably will occur in other parts of the State. It is common and frequently contains pearls, loose, or pearly excrescences attached to the valves. It is found on gravel bars and in mud.

UNIO ORBICULATUS Hildreth. Plate 50.

Shell rather large, thick, heavy, orbicular in outline, slightly compressed laterally, smooth; epidermis indistinctly radiate, dark horn-color, rather thin, eroded on the umbones; lines of growth well impressed, numerous; dorsal margin curved; anterior margin well rounded; ventral margin slightly rounded; posterior margin rounded in the male, emarginate in the female; anterior umbonal slope full and rounded; lateral umbonal slope flattened; posterior umbonal slope subangular, very much compressed from above; umbones large, not high, long, depressed, eroded; ligament long, reddish brown, thick, much elevated above the dorsal margin; lunule large, ovate; cardinal teeth short, thick, erect, heavy, nearly smooth, double in the left and single in the right valve, occasional specimens show a tendency to divide the right cardinal into three portions, of which the middle one is the largest; lateral teeth short, thick, crenately striate; anterior cicatrices distinct, very deep, rough, deeply excavated under the anterior division of the cardinal teeth; posterior cicatrices deeply impressed, striate, confluent, the portion occupied by the retractor pedis impression being very deep and excavated at the tip of the laterals; pallial line well impressed; dorsal cicatrices in a row and pit-like on the cardinal plate, with one or two very large and deep ones under the middle of the plate which connects the cardinals and the laterals;

cavity of the shell rather wide, deep, of the beaks fairly deep, rounded; nacre usually white, sometimes a warm pink.

Specimens four and one-half inches in length have been taken in the Ohio; the shell occurs also in the Wabash and the White rivers. It belongs to the group which is headed by *Unio ligamentinus* Lamarck. Dr. Hildreth and the earlier naturalists seem to have considered this shell as a variety of *Unio crassus* Say (= *Unio ligamentinus* Lamarck, short and thick variety found in the Ohio), but it certainly would seem to be a good species. From the Mississippi River Dr. Lea redescribed this shell under the name of *Unio higginsii*, in the Vol. IX, Observations on *Unio*, but there is no doubt of specific identity. The original description of Hildreth being generally inaccessible, I append it:

“Shell nearly orbicular; anterior margin broad, and slightly rounded; posterior, short and narrow; disks, much inflated; dorsal margin, lightly rounded, and basal margin the same; ligament, thick and elevated, passing between the beaks; beaks, a little projecting, distant and decorticated; epidermis, a dark chestnut on the center of the disks, passing into a light brown as it approaches the margin; surface lightly waved on the upper part of the disks, and finely wrinkled below, transversely; cardinal teeth, direct, elevated and deeply sulcated; lateral teeth thick and prominent; posterior cicatrix, deep, and rough before; anterior cicatrix, broad, finely waved; striated and beautifully iridescent; cavity, broad and deep; nacre, flesh-color, and very iridescent with purple and violet.” (American Journal of Science, Vol. XIV, First Series, page 284, 1828.)

UNIO CIRCULUS Lea. Plate 51.

Shell thick, small, circular in outline, inflated, in female emarginate posteriorly, smooth; epidermis greenish olive to dark brown or almost black, radiate especially on the posterior umbonal slope, thin, velvety and striate, polished or shining on the umbones; lines of growth somewhat raised; darker, concentric, causing a wrinkled appearance anteriorly; dorsal margin much curved; anterior, ventral and posterior margins well rounded in the male, in the female the posterior is often emarginate and shorter; anterior umbonal slope very full and round, nearly or quite parallel with the anterior margin; lateral umbonal slope full and round; posterior umbonal slope full and rounded, lighter colored with several indistinct rays that become capillary near the ligament; umbones full, high, round approximated, incurved with small concentric wrinkles near the tips, placed well forward nearly on a line with the anterior margin; ligament short, thick, ele-

vated, light brown; lunule lenticular; cardinal teeth double in the left and trifold in the right valve, thick, erect, rough, the middle division in the right valve being the larger, thicker, triangular; lateral teeth short, thick, straight, double in both valves or disposed to be so, forming a right angle with the plate of the cardinals, roughly striate; anterior cicatrices rough, deeply impressed, distinct; posterior cicatrices small, deeply impressed, distinct, that of the retractor pedis being placed at the tip of the lateral teeth; pallial line well impressed, crenulate anteriorly; dorsal cicatrices in a row on the cardinal plate, small, pit-like; cavity of the shell small, wide, of the beaks deep, triangular; nacre silvery white.

This shell is very common throughout the Ohio all along the Indiana shores; it is also numerous in the lower Wabash. Specimens in addition have been seen from the White and Eel rivers, and two from the St. Mary's River in the northeastern portion of the State. Several depauperate specimens were sent me by Professor Evermann, taken in some of the lakes of northern Indiana, but the locality record has been lost. Dr. Lea redescribed this form under the name of *Unio lens*, a species which one or two recent writers have professed to think distinct! A very depauperate form comes from Lake Erie; under the rolling of waves and beating on the bars along the shores the conditions of life are such that the animal exhausts all its energy in maintaining life rather than in building shell material. To this shell Lea gave the name of *leibii*. The characters of the shell are so well marked in Indiana that no one need err in determining the form.

UNIO RETUSUS Lamarck. Plate 52.

Lamarck described this shell in the following terms in the "Histoire Naturelle des Animaux sans Vertebres," 1819, Vol. VI, page 72; also, second edition, 1838, Vol. VI, page 534:

"U. testa rotundata, tumida, intus violacea; natibus retusis, erosis; dente laterali breviusculo. * * *

"Habite les rivieres de la Nouvelle-Ecosse. A. Michaud. Test epais; epiderme d'un vert jaunatre; dent cardinale grossiere, sillonnee, divisee en deux. Longueur apparente, 47 millimetres."

From specimens furnished by Professor Barton W. Evermann, and taken in the White River, Indiana, the following description is drawn:

Shell rotund, large, smooth, convex, heavy, rounded before, circular behind; epidermis rather thin, polished, striate, disposed to imbrication towards the margins, olivaceous, lines of growth numerous, crowded, darker; dorso-posterior margin curved and rounded; postero-dorsal umbonal slope lighter horn-colored, with numerous capillary

rays of green, which are especially marked near the beaks, this slope is separated from the lateral umbonal slope by a rather well marked angle, it has also two slightly marked carinæ; umbones large, prominent, approximating closely, curved anteriorly, and projecting slightly beyond the antero-ventral margin, smooth; ligament short, thick, curved with dorsal margin, light horn-color; lunule large, cordate, scarious; cardinal teeth single in the right, double in the left valve, multi-tuberculate, striate crenule, the folds all originating at a common point immediately under the tip of the umbone, as a whole the segments are triangular, massive, thick, short; lateral teeth long, curved, commencing well toward the dorsal margin, and nearly on a line with the anterior portion of the cardinals, lamellar, somewhat thick, double in both valves, crenulate on the margins; the plate connecting the cardinals with the laterals has several folds or plications, rather thin; anterior cicatrices distinct, deep and pit-like, not very large, the adductor roughened, the protractor pedis striate; posterior cicatrices deeply impressed, large, confluent, that of the retractor pedis at the tip of lamellæ of lateral teeth; dorsal cicatrices numerous, pit-like, often confluent, placed on the plate formed by the base of the cardinal teeth; pallial cicatrix well impressed throughout, but deepest and most crenulate anteriorly; nacre rich purple, lighter to white on the margins, beyond the pallial line.

Length of a mature specimen, 70.75 mm.; breadth, 43.50 mm.; height, 74.56 mm.

In most all of the larger streams of Indiana this shell may be sought for successfully; it has passed in review from the Ohio, White, White-water, Wabash, Eel, Kankakee, St. Joseph's rivers, and in two or three small lakes in northern Indiana. Its characters ally it to *Unio circulus*, but the color of the nacre and the very retuse beaks, directed so prominently forwards, will separate it at sight from any other form. The nacre is commonly white near the margin; all the region of the shell within beyond the edges is dark purple or chocolate, which coloring is highly characteristic. The largest and finest specimens come from the Wabash.

UNIO ELLIPSIS Lea. Plate 53.

Shell obliquely and elliptically oval, very thick, heavy, much inflated, smooth, the region of the beaks very thick; epidermis velvety in perfect specimens, striate, radiate with numerous green color lines from beak to margin, usually to be seen all over the disks, shining on the umbones, thin, olive-green in color; lines of growth numerous, darker, far apart; dorsal margin curved, abruptly so anteriorly, form-

ing an obtuse angle under the beaks, rapidly retreating towards the ventral margin, making the anterior outline very oblique; ventral margin rounded, emarginate near the posterior end in the female; posterior margin sharply rounded; umbones very full, inflated, decurved, directed forwards, viewed from the anterior the outline is cordate like a *Cardium*, tips of umbones minutely wrinkled; ligament long, thick, curved, light-brown; lunule cordate; cardinal teeth double in the left and single in the right valve, thick, erect, very variable, the divisions usually parallel with the lateral teeth, in some examples they are triangular, in others plate-like; lateral teeth long, slightly curved, very thick and heavy, roughly striate, the lower plate usually somewhat thickened near the end; anterior cicatrices very large, rough, deep, distinct; posterior cicatrices distinct, large, deeply impressed; pallial line deep and crenulated anteriorly; dorsal cicatrices numerous, pit-like, in the center of the cavity of the beaks; cavity of the shell wide, of the beaks rounded and shallow; nacre pearly white.

The largest of four specimens on which this description is based measures two and three-fourths inches in length; two and one-eighth inches in height; one and five-eighths inches in width. Specimens are often found which are much larger. The largest come from northwestern Missouri and eastern Kansas, to which Dr. Lea gave the name of *Unio pealii*, now a recognized synonym. In Indiana specimens have been seen from the Ohio and Wabash rivers, where the form is very abundant. It is a very common species on the Falls of the Ohio at Louisville. It may be found in all kinds of bottoms, rocky, gravelly, sandy or muddy; it is the most common shell to be found around muskrat burrows on the Wabash. The peculiarly oblique character of the shell, the way the beaks project anteriorly, and the teeth will enable its ready recognition.

UNIO CYPHYUS Rafinesque. Plate 54.

Shell suboval, somewhat flattened laterally, incrassate anteriorly, thinner over posterior region, sometimes obscurely tuberculate from middle of umbonal slope to ventral margin, the obtuse tubercles being alternately disposed and usually largest about the middle of the disk; the anterior margin is regularly rounded as far as the regions of the umbonal tubercles, then usually emarginate or sulcate, a character which is particularly well marked in the old female and the very young; growth striæ numerous, crowded, and conspicuous, the lines indicating arrest of growth being darker and broader, well marked and rather deeply impressed; ligament light brown, smooth and flat-elliptical; lunule evident and somewhat cordate; the beaks are coarsely and con-

centrically undulate, the undulations numbering three or four, with the epidermis somewhat lighter in color than that on the slopes of the umbones; cardinal teeth single in the right, and double in the left valve, triangularly pyramidal; lateral teeth double in the left, and disposed to be double in the right valve, nearly or quite straight in old specimens, or slightly curved downward in the very young shell, thick; anterior cicatrices distinct, pit-like and deeply impressed; posterior cicatrices distinct, well impressed, that of the retractor pedis being more distinctly marked than the posterior adductor, and impressed at end of lateral teeth; pallial cicatrix faintly impressed and somewhat sinuous; cavity of the beaks shallow and rounded, with numerous, linear, minute muscular impressions posterior to the base of the cardinals and often upon them; epidermis straw-yellow or honey-brown in color, the young specimens occasionally found with hair-like green rays, which are, however, confined to the umbonal slope; nacre pure white and somewhat iridescent posteriorly.

Geographical Distribution.—This shell ranges from western Pennsylvania to the Alabama River, Alabama, and westward to Iowa and Minnesota. In the rivers of the middle Ohio drainage and in Iowa it is a common and beautiful species. The animal is of a deep salmon color, which character should assist in separating it from its congeners.

In Indiana this shell is found only in the Wabash and Ohio rivers, so far as my personal knowledge extends. But it is common in the deeper waters of those streams, varying in color from dark brown to light yellow, according to age and station.

This species has a very interesting history which I have elsewhere fully given, and the main facts of which are reproduced herewith; this seems to be justified by the fact that Rafinesque's name has never been employed for this form, which is common in collections under Dr. Green's name.

In 1827 Dr. Jacob Green* obtained from "the rivers in the neighborhood of Pittsburg" an undescribed *Unio* to which he gave, with formal description, in Contributions of the Maclurian Lyceum to the Arts and Sciences, I, p. 45, July, the name *Unio œsopus*. Later investigations developed the wide distribution in the rivers of the west of this shell; but its original description is so rarely seen that nearly

* Jacob Green, M.D., was born in Philadelphia on the 28th of July, 1790; he died in that city on February 1, 1841. He was well and favorably known as an educator, and was for a number of years professor of chemistry in the Jefferson Medical College. His scientific work was not extensive, but was of a most excellent character. He was a distinguished student of mollusca and of trilobites. He was the discoverer of that small but most interesting form from the Utica Shale known as *Triarthrus beckii*.

all modern identifications are traditional. Frequently this highly characteristic shell is received from collectors under the various names of *Unio rubiginosus* Lea, *Unio coccineus* Lea, and occasionally with specimens of *Unio ellipsis* Lea. The plate which Dr. Green designed to illustrate this species is a very fine specimen of early lithographing, and very well exhibits its characters; the male shell was employed.

The original description was as follows:

“*Testa ovata, antice undato angulata, compressa, postice orbiculata, transversim sulcata et rugosa; rugis prope margines obsoletis, serie nodulorum a natibus versus margines, inferiorem decurrente, instructis; natibus decorticatis et leviter erosis; periostracha nitida, luteo fusca; intus alba iridescente; dentibus crassis, striatis.* Plate 3.

“*Hunched Unio.*—Shell oval compressed, thin and slightly angular at the anterior end or margin, regularly rounded, convex and thick at the posterior margin, slightly incurved and but little eroded, from the beaks over the disk and near the middle of the shell there is a remarkable gibbosity or nodulous ridge, produced by the striæ becoming in this place remarkably thick and tuberculated. There appears also in some specimens the indications of a second ridge near the anterior end; both these ridges are alternately raised and depressed; periostracha much wrinkled by the striæ, of a light horn-color, and remarkably glabrous, in old and young specimens, it is darker than the perfect shell, and the young are often beautifully rayed and spotted with brown; nacre commonly white, pearly and iridescent; teeth moderately thick, length about two inches, breadth about four.

“This shell inhabits probably all the western waters; and it is a little remarkable that Professor Rafinesque, who has described and figured so many of the Unionidæ, should have omitted this remarkable species. I found eight or ten of these shells in the river in the neighborhood of Pittsburg. In old shells the anterior margin is often produced and truncated, and the young specimens seem to be peculiarly liable to a preternatural enlargement of some portions of the shell more than others.”

Seven years prior to this description Professor Rafinesque had described a shell from the Falls of the Ohio River, at Louisville, Kentucky, where *Unio œsopus* is a common form, to which he gave the name *Obliquaria cyphya*,* and which he has characterized as follows:

“29. Espèce. *Obliquaria cyphya* (*Unio cyphia*). *Obliquaire cyphie.*

“*Test épais bombé, bosselé, bord flexueux, en talus postérieurement;*

* *Vide: Annales Générales des Sciences Physiques, Bruxelles, Septembre, 1820, p. 305.*

épiderme brun-châtain; tubercule à rides flexueuses; nacre blanche. Longueur 8-9; diamètre et axe 5-9 de la largeur.

“Largeur 2 à 3 pouces; test plus épais antérieurement, à grosses rides et à quelques tubercules oblongs; une grosse bosse oblique longitudinale; dents épaisses striées. Aux chutes de l’Ohio.”

Rafinesque did not attempt to figure this species, as he had done with most of the shells described in his memoir. In the absence of a good figure only his technically imperfect and brief description may be relied on to furnish a clue to the shell he intended in this case. There has never been much question in my mind that he had *Unio œsopus* before him when he made his diagnosis. No other Ohio River *Unio* could possibly satisfy the characters here given. The single character of “chestnut-brown epidermis” alone is not true of all specimens of this form, but such examples are often found. The original description is here repeated that the reader may himself decide whether a careful review of the species will not credit the form to Rafinesque.

In accordance with custom, the specific name of all these forms is given the masculine ending, believing that the proper form of *Unio* is masculine; the specific name being simply an adjective, it must conform in gender to that of the noun to which it applies.

UNIO VARICOSUS Lea. Plate 55.

Shell very large, heavy, thick, very ponderous anteriorly and in the region of the umbones, with a number of coarse longitudinal folds or varices on the lateral umbonal slope, polished on the umbones, outline elliptical-ovate, oblique anteriorly; epidermis thick, dark brown, eradiate, striate and imbricate towards the margins, lighter colored on the posterior umbonal slope; lines of growth numerous, coarse, crowded especially so anteriorly, impressed, aiding to give the shell a roughened appearance; dorsal margin obliquely curved; anterior margin abruptly rounded, short, oblique; ventral margin full, rounded; posterior margin much produced, biangular, emarginate, obliquely rounded to meet the dorsal margin; anterior umbonal slope somewhat excavated, overhanging which are the long umbones; lateral umbonal slope full, round, with seven to eight coarse folds which are placed on the lines of growth; posterior slope sulcate, then angulate, the portion nearest the dorsal margin much compressed, striate, imbricate especially near the posterior margin, with one or two very indistinct hair-line-like ridges extending from the beaks; umbones very large, full, curved anteriorly and at the same time decurved, widely separated, triangular, exceedingly thick and heavy; ligament very

large, long, curved, thick, wide, dark brown; lunule very large, triangular, black, membranaceous; cardinal teeth large, thick, heavy, erect, lines drawn through them would be mainly parallel to the dorsal margin, double in both valves, but made up of many coarse plates in the left valve, coarsely striate, serrate on the margins; lateral teeth large, thick, curved, double in the left and disposed to be trifid in the right valve, coarsely striate, thicker at extremities; anterior cicatrices large, very deep, very rough, distinct, that of the anterior retractor pedis deeply impressed on the base of the cardinal teeth; posterior cicatrices very deeply impressed, striate, that of the retractor pedis deeply impressed at the tip of the lateral teeth; pallial line deeply and crenately impressed anteriorly; dorsal cicatrices large, impressed in the umbonal cavity just posterior to the cardinal plate; cavity of the shell large and wide, cavity of the beaks rather deep, rounded, broad; nacre pearly white.

The specimen from which the above description is drawn is from the Wabash and is a very large and old shell; but its characters are permanent. The form was described from the Ohio River, at Cincinnati, by Dr. Lea; in the Ohio the shell is common. Large specimens were collected in that stream near Charleston, in 1894, rivaling the dimensions of the one herein figured. The shell is very oblique because of the way in which the beaks are placed, being so far forward that they form, when viewed from the front, the outline of a large *Cardium*. The shell is close to *Unio cyphus* Rafinesque, and it may, indeed, be mistaken for an old specimen of that species; the animal is similarly colored. It is readily identified among all found in the Ohio or Wabash, the only Indiana streams from which I have seen this shell.

UNIO COCCINEUS Lea. Plate 56.

Shell thick, rather large, somewhat inflated, suborbicular in outline, pointed posteriorly, smooth, polished on the umbonal slopes; epidermis dark horn-color, in some specimens greenish-olive, rayed, especially so on the umbones of young specimens, thin, smooth, striate near the margins; lines of growth distinct, darker, concentrically arranged, crowded anteriorly, somewhat imbricate posteriorly; dorsal margin curved, very much so in the region of the umbones; anterior margin slightly produced, rounded; ventral margin rounded; posterior margin slightly emarginate, produced, pointed, biangular, forming an obtuse angle where it meets the dorsal margin; anterior umbonal slope rounded and full; lateral slope rounded, inflated; posterior umbonal slope somewhat angular, gradually compressed towards the dor-

sal margin, with two or three faint carinæ extending from the region of the beaks to the margin; umbones full, not greatly elevated, approximated, with two or three coarse folds which best show in young specimens; ligament large, thick, wide, black; lunule oval, large, black, membranaceous; cardinal teeth large, thick, triangular, rough serrate, double in the left and single in the right valve; lateral teeth large, long, thick, straight, striate, double in the left and single in the right valve; anterior cicatrices very large, deep, rough, distinct, excavated under the anterior portion of the cardinals; posterior cicatrices distinct, rather deeply impressed, that of the retractor pedis large and at the tip of the lateral teeth; dorsal cicatrices near the margin of the cardinal plate; pallial line impressed crenately near the anterior end; cavity of the shell large, wide, of the beaks deep and wide; nacre white or warm pink color.

This is a common shell in all portions of Indiana. Specimens have been seen from the Ohio, White, Wabash, Eel, Whitewater, Blue, Kankakee, St. Mary's, St. Joseph's rivers and from several of the lakes in northern Indiana. From the Eel river come the largest and finest specimens I have ever seen. They are the variety with white nacre to which the name *Unio gouldianus* has been given. The typical form of *coccineus* has a warm pink nacre; in all streams where one color occurs the other may also be found. The females are often much emarginate posteriorly and the males often much produced. This shell is commonly found in collections mixed in trays with *Unio rubiginosus* Lea which it greatly resembles; it lacks the marked angle on the posterior slope which is characteristic of the older known form. The markings on the beaks of the young specimens are entirely unlike and some of each should be taken to aid in separation.

UNIO OBLIQUUS Lamarck. Plate 57.

Shell heavy, sulcate, thick, large, triangularly cordate, wrinkled parallel with the lines of growth, compressed on the posterior umbonal slope, turgid or swollen at the umbones, very solid and thick anteriorly; epidermis rather thick, striate, especially at the margins, black or corneous, olivaceous in the young, eradiate except in the young; lines of growth numerous, impressed, crowded; dorso-posterior margin, in the old, arcuate, almost circular in old specimens; posterior umbonal slope rounded, much produced in old specimens, with rather marked angle at junction with posterior margin; ventral margin disposed to be sulcate; anterior margin rounded, scarcely produced, not as far forward as the umbonal tips; umbones large, very thick, turgid, somewhat produced beyond the anterior margin, approximating in

perfect specimens, minutely undulated at tips; ligament large, thick, long, black, curved parallel to the dorsal margin; lunule large, cordate, black; cardinal teeth large, heavy, short, bifid in the left and disposed to be trifid in the right valve, rough, striate-crenulate, all segments departing at varying angles from a point immediately under the apex of the umbones, the dorsal division in the left valve the largest and heaviest, and parallel to the cardinal teeth; plate joining cardinal teeth with the laterals short, thick, smooth dorsally, but striate ventrally, margin somewhat crenulate; lateral teeth long, thick, slightly curved ventrad, striate-crenulate, rough; anterior cicatrices deep, rough-pitted, distinct, outline of the adductor somewhat triangular, that of the protractor pedis elliptical, behind rather than under the adductor; posterior cicatrices distinct, well and deeply impressed, the adductor concentrically striate; the retractor pedis circular, pit-like, impressed just below the ends of the lateral teeth; pallial cicatrix broad, crenulate, well impressed throughout, but not deeply impressed anteriorly; dorsal cicatrices not impressed in the cavity of the beaks, but as a broad row on the posterior margin of plate formed by the cardinal teeth, numerous and rough; nacre white, in some specimens with occasional brownish blotches, iridescent posteriorly; dimensions of average mature specimen: length, 95.56 mm.; breadth, 45.00 mm.; height, 77.40 mm.

Lamarck's original description was as follows:

"*U. testa sublongitudinali, ovato-rotundata, obliqua, subepiderme candida; ligamento subduplici; dente cardinali crasso, sulcato, biparartito.*

" * * * Habite la riveire de l'Ohio. A. Michaud. Distincte de la precedente par sa forme: elle est renflée vers les crochets, déprimée vers l'autre extrémité, bisillonnée sur le côté antérieur. Longueur apparent, 61 millimetres." (Hist. Naturelle des Animaux sans Vertèbres, 1818, Vol. VI, page 72; also *ibid.* edition of 1838, Vol. VI, page 534.)

I have seen specimens of this shell only from the Wabash and the Ohio; it seems to be confined to the larger streams only. It is especially abundant in the Ohio and is often found in collections with *Unio ebenus* under that name. It may be easily distinguished by the sulcation on the posterior slope and by the character of the beaks, those of the *ebenus* being much less triangular and more produced. The specimen figured is from the Cumberland River, Tennessee, where the form occurs in the greatest perfection.

UNIO EBENUS Lea. Plate 58.

Shell large, thick and heavy, especially thick anteriorly, and in the region of the beaks, striate, smooth otherwise, oval in outline, viewed anteriorly the outline is cordate; epidermis dark brown or black, especially in old specimens, thick, striate, imbricated posteriorly, in the very young a few faint lines or rays on the umbones; lines of growth numerous, raised, concentric, crowded near the margins and anteriorly; dorsal margin roundly curved, the curve passing directly into that of the anterior margin; ventral margin nearly straight; posterior margin biangular, subcircular; anterior umbonal slope very full and round, flattened towards the anterior margin; lateral umbonal slope full and round, inflated; posterior umbonal slope long, decurved, with two broad carinae extending from the beaks to the posterior margin, the carinae being decurved and terminating at the siphonal openings; umbones very large, full, rounded, curved greatly anteriorly and downwards, widely separating, ending in a sharp tip; ligament light brown, long, thick, greatly curved; lunule very large, triangular, membranaceous, black; cardinal teeth large, heavy, thick, not much elevated, rough, striate, double in right and single in the left valve, dorsal portion of the teeth much curved; lateral teeth long, thick, heavy, striate, especially so near the ends, double in the left and single in the right valve; anterior cicatrices very large, rough, distinct, deeply impressed; posterior cicatrices very large, well impressed, striate, beautifully iridescent, that of the retractor pedis very large and impressed back of the ending of the lateral teeth, posterior cicatrices distinct; pallial line deeply and crenately impressed; dorsal cicatrices on the plate between the cardinals and laterals and very near the margin; cavity of the shell large, of the beaks large, deep, triangular, excavated far into the umbones; nacre white, iridescent posteriorly, with occasional brownish patches on the lateral teeth or on the disk.

This shell is the largest of the subrotund shells in this State, and like the preceding, attains its maximum development in the larger streams. The specimen figured and described came from the Wabash River, at Terre Haute. It measures four inches in length, three and one-fourth inches in height, two and one-fourth inches in width; larger specimens are common in the Ohio. A large bed of this species occurs in the Ohio about half way between Aurora and Lawrenceburg, and with them are associated many of the Ohio River shells of both great size and profusion. The beaks are well produced forwards and will aid in separating the form.

UNIO SOLIDUS Lea. Plate 59.

Shell large, thick, heavy, very thick in the region of the umbones, obliquely triangular, roundly cordate when viewed in front, sulcate, smooth; epidermis dark horn-color, honey-yellow in some specimens, radiate in the young, thin, striate near the margins; lines of growth numerous, raised, crowded, imbricated near the margins all around in old shells; dorsal margin obliquely curved, the anterior portion passing almost insensibly into the straight anterior margin; ventral margin full and round, emarginate posteriorly; posterior margin biangular, oblique, produced; anterior umbonal slope full and sharply rounded, slightly excavated under the beaks; lateral umbonal slope full and inflated; posterior umbonal slope sulcate, subangular towards the umbones, with two distinct but obtuse carinæ which end at siphonal openings; umbones large, high, directed anteriorly, but on a line, or but little above it, with the ligament, smooth, triangular near the tips, which do not touch; ligament long, curved, brown, thick; lunule large, cordate, membranaceous; cardinal teeth very large, erect, thick, striate, serrate, double in the left and disposed to be trifid in the right valve, triangular; lateral teeth long, slightly curved, thick, striate, rough; anterior cicatrices distinct, very deep; posterior cicatrices distinct, deep, concentrically striate, that of the retractor pedis at the tip of the lateral teeth, very deep; pallial line well impressed anteriorly where it is crenulate; dorsal cicatrices on the plate of the cardinal teeth; cavity of the shell wide, deep, of the beaks deep and broadly triangular; nacre pink, with white towards the margins, iridescent.

One of the most difficult of the groups of *Unio* is typified by this form which belongs to the group headed by *Unio obliquus*. A number of species have been made from this and closely related shells which will certainly prove to be synonyms; but this is not the place to consider the group as a whole. *Unio solidus* is found only in the Ohio and the Wabash in this State; it is not a common species so far as my observations go. A closely related form, called by Lea *Unio plenus*, is probably this form with pure pink nacre, at least I have so considered it in this catalogue and do not describe *plenus*. The whole matter of these forms is in a state of great confusion and should be cleared up.

UNIO TRIGONUS Lea. Plate 60.

Shell thick, heavy, triangular in outline, inflated, striate, slightly sulcate; epidermis thin, greenish-yellow, sometimes honey-yellow to dark brown according to age or station, faintly radiate in the old, markedly so in the young specimen, often velvety; lines of growth

numerous and crowded, often darker; dorsal margin curved, forming an obtuse angle at junction both with anterior and posterior margins; anterior margins at first straight, then curved towards the ventral margin, which is nearly straight and sometimes emarginate; posterior margin biangular, produced, oblique; anterior umbonal slope full and round; lateral umbonal slope subsulcate, inflated anteriorly; posterior slope angular, with two slightly raised lines from the umbones to the posterior margin, viewed from the dorsal aspect greatly flattened; umbones large, prominent, triangular, decurved, placed well forward, tips with a few coarse folds, approximating; ligament short, thick, high, dark brown; lunule short, triangular, membranaceous; cardinals erect, short, serrate, thick, rough, single in both valves but so divided into smaller parts as to closely interlock; laterals long, slightly curved, thick, striate; anterior cicatrices very deep, rough, small, distinct; posterior cicatrices very deep, distinct, that of the retractor pedis at the end of the lateral teeth; pallial line fairly well impressed, crenate anteriorly; dorsal cicatrices in a group on the plate between the cardinals and laterals; cavity of shell large, deep, wide, of the beaks widely triangular, deep; nacre white or sometimes tinged with pinkish.

Both the Ohio and Wabash furnish fine and large examples of this species, which is common throughout the Mississippi Valley, and has had a variety of names affixed to it. *Unio trigonus* is a very variable shell in its shape and degree of inflation, but in other characters seems to be a well defined species. The nacre is often white, through salmon to deep pink, and sometimes has these colorings only in the region of the beaks. It is often confused with the following form, which is the type of the group to which it belongs, but is less flat, larger, thicker and more narrowly angular in the region of the umbones. At Lawrenceburg the species is abundant in muddy bottoms and sometimes is found crawling around on gravel bars; it is a less active species than the following.

UNIO RUBIGINOSUS Lea. Plate 61.

Shell rather large, not very thick, thicker before, quadrate in outline, compressed laterally, striate, the females often much produced posteriorly; epidermis olive green or brown, thin, shining on the umbones, striate elsewhere, otherwise smooth, occasionally young specimens are taken with rays in the region of the umbones; lines of growth numerous, darker, sometimes raised, making faint longitudinal ridges; dorsal margin somewhat curved; anterior margin well rounded; ventral margin slightly emarginate; posterior margin decurved, biangular, oblique; anterior umbonal slope rounded, not much inflated, lateral

umbonal slope flattened from the beaks to the margin; posterior slope angulate, rapidly compressed towards the dorsal margin; umbones small, somewhat raised, triangular, decurved, placed near the middle of the shell, with a few coarse folds which are most marked along the posterior angle near the umbones, lighter in color than the rest of the shell; ligament short, thick, clavate, dark brown; lunule variable, small, ovate; cardinal teeth double in the left and single in the right valve, erect, triangular, thick, short, striate; lateral teeth long, thin and plate-like, nearly straight; anterior cicatrices distinct, rather large, deeply impressed; posterior cicatrices distinct, deeply impressed, that of the retractor pedis at end of lateral teeth; pallial line not deeply impressed; dorsal cicatrices on the base of the cardinal teeth; cavity of the shell shallow, of the beaks deep and triangular; nacre white, sometimes ruddy or pinkish.

The length of mature specimens varies from two inches to more than four inches; the width rarely exceeds one inch.

In every part of Indiana, in streams both large and small, in lakes and ponds this shell may be found. It is the most common *Unio* within its limits. It is a mud-loving form, but is very active and may be found in all kinds of stations. A very depauperate form is found in the lakes of the northern part of the State; not only are the shells depauperate but they are thinner than those which occur in rivers. *Unio rubiginosus* ranges from New York to Texas, in all stations, and is correspondingly variable. The specific name is based on the reddish-salmon colored animal; comparatively few shells have colored nacre, but they are fairly common.

UNIO CLAVUS Lamarck. Plate 62.

This shell is one of those prolific sources of synonymy with which the descriptive matter of American fresh-water conchology has become burdened. In the hope that it will subserve a useful purpose the original description of Lamarck follows, and the synonymy as now understood, excepting only those names which have not been accompanied by figures:

"*U. testa sublongitudinali, oviformi, inferne tumida, obtusa; postico latere brevissimo; dente laterali prælongo.*

Var. testa versus extremitatem lateris antici sensim depressa, magis attenuata.

Unio modioliformis Say, Amer. Conch.

*Habite dans le lac Erie. Michaud fils. * * * Test tres blanc. Longueur apparente 72 millimetres La variete b vit dans la riviere de la Nouvelle-Ecosse. * * * Longueur apparente 53 millimetres."*

Lamarck's brief description is no doubt responsible for very much of the confusion which attends the separation of this form. To aid in its correct determination the following description has been drawn, from specimens collected in the Duck River, Tennessee. The specimen figured is one of those employed in this diagnosis.

Shell smooth, somewhat elliptical, most of its mass posterior to a line drawn vertically from the umbones, laterally subcompressed, somewhat pointed posteriorly, circularly rounded before; umbones prominent and pointed anteriorly, apiculate; ligament large, thick, light brown; epidermis honey-yellow, smooth, often polished, rayed from the tips of the umbones with green lines over the first formed half of the disk, the rays broadening downward, occasionally interrupted by the lines of growth which are numerous and strongly impressed giving to the lower third of old specimens a striate appearance; umbonal slope rounded anteriorly but compressed posteriorly; in the female, the posterior slope is rather less flattened than in the male, while the outline of the disk is less pointed; cardinal teeth single in the right, double in the left valve, rather short and incrassate, crenulate; plate connecting laterals with the cardinal teeth disposed to folding in the left and pitted in the right to correspond, thick, slightly arched; lateral teeth long-lamellar, curved ventrad, striate; anterior cicatrices confluent, deeply impressed, that of the retractor pedis impression very deep and circular and at the end and lower margin of the lateral teeth and partly on them; dorsal cicatrices numerous, small and impressed in an irregular line on the under side of the plate between the cardinal and lateral teeth; nacre pure white, with a very marked iridescence posteriorly between the pallial cicatrix and the margin.

Length, 53.00 mm.; breadth, 18.50 mm.; height, 30.00 mm.

The synonymy of this species has been but partially worked out, but it is certain that it will include the following forms:

Unio patulus Lea. 1829. Trans. Am. Philos. Soc., Vol. III, p. 409, Pl. XII, fig. 20.

Unio decisus Lea. 1830. Trans. Am. Philos. Soc., Vol. IV, p. 92, Pl. XII, fig. 23.

Unio chattanoogaensis Lea. 1858. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. IV, 1859, p. 209, Pl. XXV, fig. 90.

Unio consanguineus Lea. 1861. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. V, p. 67, Pl. VII, fig. 217.

Unio pallidofulvus Lea. 1861. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. V, pp. 83-85, Pl. XI, fig. 232.

Unio interventus Lea. 1861. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. V, p. 84, Pl. XI, fig. 233.

Unio concolor Lea. 1861. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. V, p. 89, Pl. XII, fig. 237.

Unio anaticulus Lea. 1861. Jour. Acad. Nat. Sci. Phila., 2d series, 1862, Vol. V, p. 92, Pl. XIII, fig. 240.

Unio crebrivittatus Lea. 1861. Jour. Acad. Nat. Sci. Phila., Vol. VI, 1866, p. 43, Pl. XV, fig. 41.

Unio curtus Lea. 1859. Jour. Acad. Nat. Sci. Phila., 2d series, Vol. V, 1861, pp. 92-103, Pl. XVII, fig. 253.

Both this last named form and *Unio anaticulus* were based on deformed specimens of *Uniones* and are, in a certain sense, pathologic forms. To this synonymy must be added those other names under which Say described this species a leading term of which will be *Unio modioliformis*, as has been noted by the editors of Lamarck, in 1838. Other great groups of *Uniones* there are which exhibit a far larger synonymy than does that group which this species of Lamarck heads.

So far as known this form does not occur west of the Mississippi, nor has any member of the group been found which may be located west of that stream. It has its greatest development in the mountain regions of Georgia, Alabama, Kentucky and Tennessee, though its ranges, as specimens at hand prove, from western New York to Ottawa River, Canada, thence west to Illinois and south to middle Alabama, where some of its forms are exceedingly abundant in the streams of north-central Alabama, notably in the Coosa, Alabama and Cahaba rivers.

A good illustration of this common Indiana shell may be found in Conrad's Monograph, Pl. III, fig. 1; also in Tenney's Manual of Zoology, edition of 1872, fig. 460, p. 492. Reeve, in his Conchologica Iconica, Pl. LXIX, fig. 354, also fairly well illustrates it, but the beaks are represented to be more decurved than in any specimen we have ever seen.

In Indiana the species has been collected in the Ohio, Wabash, White, Whitewater, Eel and St. Mary's rivers, and it is likely to be found in many other streams. It must be borne in mind in this case, and in the cases of all other Indiana shells, that the range which is given in this catalogue may be greatly extended on careful examination of the whole State, a study which yet remains to be made. Such a study ought to be undertaken. At Indianapolis ought to be gathered a complete and full representation of all the animals of the State; the mollusca should be fully represented in such a collection. In passing, it may be remarked that the largest and finest shells of this form ever collected personally were taken near North Manchester, in the

Eel River. They are now in the Museum of Comparative Zoology, and are magnificent examples of this species.

UNIO CRASSIDENS Lamarck. Plate 63.

When Lamarck described this form he included in it a variety of shells, some of which were entirely distinct and are now recognized as other valid species. Such for example, is his variety *a*, which is said by Dr. Lea, who saw the type in Paris, to be his *Unio trapezoides*; it is therefore quite distinct from *crassidens*. The original description here follows from the *Animaux sans Vertebres, second edition*, Vol. VI, page 532, 1838:

“U. testa ovali, tumida, crassa; postice rotundata, antice, angulis binis ternsive subsinuosa, dente cardinali crassissimo lobato, angulato, striato.

“Habite l’Amerique septentrionale, dans le Mississipi, l’Ohio, et plusieurs lacs. * * *”

The remainder of the description is concerned with the diagnoses of the varieties which Lamarck considered as belonging to this form. Variety *a* is from the Mississippi; variety *b* from Lake Erie, variety *c* from the Ohio. But each variety appears to be a distinct species.

The following description is based upon specimens obtained from the Cumberland River, at Nashville, Tennessee, where the species is very abundant; also facts are included from characters exhibited by abundant material from the Etowah and Oostanaula rivers, in Georgia. The species is likewise abundant in the Cahaba, Alabama and Coosa rivers, in Alabama.

Shell smooth, elliptical, compressed, incrassate anteriorly, biangular and much thinner posteriorly; epidermis rather thick, black in old specimens and deep reddish brown in young ones, striate, often with curved, dark green rays extending ventrad from the umbones, in the young shell; the dorso-posterior margin much and quite regularly curved; posterior umbonal slope eradiate, somewhat flattened, separated from the lateral slope by a marked angle, with a prominent raised line, sometimes two, extending from the umbones and joining the posterior margin at the angles, the whole posterior slope is, commonly, strongly and coarsely striate; umbones small, scarcely prominent, slightly incurved; ligament long, thick, curved with dorsal margin, black; cardinal teeth short, heavy, triangular, striate, single in the right, double in the left valve, the posterior portion of the double left tooth nearly equal in size and shape to the single right tooth; lateral teeth long, thick, straight or nearly so, crenulate, in old specimens this is strongly marked; dorsal plate connecting the lateral with the

cardinal teeth scarcely marked, smooth, rounded; anterior cicatrices distinct, deeply impressed, that of the adductor muscle much roughened and pitted with numerous small pits arranged in a row near the edge of the plate forming its upper margin; pallial cicatrix well impressed anteriorly and markedly crenulate throughout; posterior cicatrices distinct, that of the adductor deeply impressed and extending to the posterior end of lateral teeth, striate, that of the retractor pedis muscle deep, pit-like, sometimes confluent with that of the adductor; cavity of the beaks shallow, with a row of minute pit-like dorsal cicatrices some distance within the margin of the plate; nacre rich purple, light, iridescent, the latter feature especially marked posteriorly.

Length, 111.25 mm.; height, 69.00 mm.; width, 40.00 mm.

In the State of Indiana only the Wabash and Ohio rivers have yet presented this shell, so far as personal knowledge extends. In the Mississippi the form is commonly smaller than in the Ohio, where it attains a very great size; the Wabash specimens are also smaller. The habits of this shell are very interesting; it is not a very active shell, but remains fastened in the river bottoms by its long and powerful foot; it occurs in hundreds in beds in muddy bottoms, and is sometimes swept out by great floods by bushels, as at the lower end of the Falls of the Ohio, near Louisville. A fine figure, rather too highly colored, is given by Mr. George F. Kunz in his paper on Pearls and Pearl Fisheries before alluded to. It is a coarse shell, very common, and can not be mistaken for any other species.

UNIO FOLIATUS Hildreth. Plate 64.

Shell large, thick, heavy, very thick anteriorly and in the region of the beaks, sulcate, emarginate, the female especially so, male trapezoidal in outline, female irregularly quadrate, the posterior being sinuously emarginate, compressed laterally, inflated at the middle third of the disk; epidermis dark horn-color, striate, thick, indistinctly radiate, in the absence of color the radiations take the form of slightly impressed capillary rays; lines of growth numerous, darker, somewhat imbricated posteriorly in the male and very much so in the female, particularly in old shells; dorsal margin roundly curved; anterior margin rounded, full, somewhat produced; ventral margin straight in the female, emarginate in the male; posterior margin pointed and biangular in the male, very greatly emarginate in the female, with two prolongations, one near the dorsal aspect and one near the ventral margin, which character gives the specific name to the shell; anterior umbonal slope roundly compressed; lateral umbonal slope sulcate, the sulcation passing to the ventral margin in the male, to the posterior

margin in the female, the disk raised into a pronounced angle over the lower two-thirds; posterior umbonal slope obtusely angular, the angle passing backwards very near the dorsal margin and decurved, the shell gaping at the siphons, posterior slope very greatly depressed near the dorsal margin, giving that portion of the shell a flattened appearance; umbones full, not greatly elevated, trapezoidal in outline, eroded and embryonic shell characters not observed; ligament short, brown, thick, somewhat elevated; lunule small, elliptical, pointed at both ends; cardinal teeth double in both valves, erect, thick, triangular, striate, dentate; lateral teeth short, thick, curved, striate, swollen near the extremities, double in both valves; anterior cicatrices large, distinct, deeply impressed; posterior cicatrices distinct, deep, rather large, concentrically striate; pallial cicatrix well impressed anteriorly; dorsal cicatrices in a row on the plate of the cardinals; cavity of the shell large, of the beaks shallow, broadly triangular; nacre white and iridescent.

Specimens have been seen which are somewhat larger than those figured, but they are rare. The figures are natural size and give a fairly good idea of the shell and its peculiar dimensions. It is a very rare species and is by no means common in recently formed collections. I have never seen any examples except from the Ohio River. In the Call Collection at the Museum of Comparative Zoology there are eight or ten fine examples, and to the courtesy of the officers of that institution I am indebted for the privilege of using some of my former private collection for figuring. I give illustrations of both male and female. The shell should be sought in deep and muddy bottoms, and if one or two shells in a season be found the collector may well think himself rewarded, so rare is the species. Since the original description is now difficult to consult, I here reproduce it, that the history of the species may be complete for Indiana students:

“Shell shaped like a grape leaf, surface waved; disks swelled; base arcuated, and anterior margin deeply emarginate.

“Length, 2.00; breadth, 2.00; diameter, 1.12. Hab. Ohio.

“Shell compressed and deeply emarginate before; rounded and projecting behind; beaks flat and eroded; ligament more elevated than the beaks, and passing between them; hinge margin broad and straight; anterior dorsal margin projecting; anterior margin, emarginate; anterior basal projecting; basal margin arcuated; two elevated ridges, extending from the beaks, and projecting on the anterior dorsal and basal margins, with a broad furrow between; epidermis dark olive; waved transversely and obscurely rayed with green, across the waves; cardinal teeth small, and that in the right valve deeply

sulcated; lateral teeth short and thick; posterior cicatrix deep and smooth; anterior one strongly impressed and rough behind; cavity broad and shallow; nacre white, tinged with a beautiful pea-green; iridescent on the fore part.

“Remarks.—Having but one specimen of this shell, I am unable to determine whether it is a new variety, or only a ‘*lusus naturæ*.’” (American Journal of Science, Vol. XIV, page 285, plate unnumbered, Fig. 16, 1828.)

UNIO PARVUS Barnes. Plate 65, figs. 1-4.

The type of this species is a small unionine bivalve from the Fox River, Wisconsin, collected by Mr. H. R. Schoolcraft, while engaged in work on the Northwest Expedition, of the early part of the present century. The type was described by Mr. D. H. Barnes, in 1823, in the following words:*

“Shell oblong-ovate, small, convex, sides rounded; beaks slightly elevated, inside pearly white, iridescent. * * *

“Diameter, .35-.525; length, .4-.6; breadth, .75-1.2.

“Shell rather thin, beaks placed about one-fourth of the length from the posterior extremity, ligament very narrow, anterior lunule distinct and obsoletely ribbed; basal margin slightly shortened; epidermis brownish; an obtuse, slightly elevated rib from the beaks to the anterior basal margin; lateral tooth rectilinear, rounded at the end, and parallel to the base; nacre very brilliant.”

Mr. Barnes completes his diagnosis of this form with the remark that it is “the smallest and most beautiful of all the genus yet discovered in America.”

In geographic distribution this small mollusk ranges from western New York and Florida to Minnesota, Texas and Arkansas. In this wide range there are numerous diverse environmental conditions, and the species appears, in a definite sense, to have responded to these, and thus have been produced a number of variations, which, passing through the hands of different naturalists, have been elevated into specific rank. In some cases, indicated below, the sexes have been made to serve as the basis of new species. Full series, collected over the wide area of distribution, confirm the following synonymy, in which the geographic distribution of several of the forms conveys its own argument:

Am. Jour. of Sci. and Arts first series, Vol. VI, 1823, p. 274, Fig. 18; Lea figures the animal in Jour. Phila. Acad. Nat. Sci., second series, Vol. IV, Pl. XXIX, Figs. 102, 102a; Conrad, Monography of Unio,

*American Jour. of Sci., 1st Ser., Vol. VI, No. 2, p. 274, pl. 13, fig. 18, outline only.

1836, Pl. IX, Fig. 1; Reeve, *Conchologia Iconica*, Vol. XVI, *Unio* Pl. XXXV, Fig. 186, a very poor figure from a specimen in the Museum Cuming.

Unio paulus Lea. *Trans. Am. Philos. Soc.*, Vol. VIII, 1840, p. 213, Pl. XV, Fig. 29. From the Chattahoochee River, Georgia.

Unio minor Lea. *Trans. Am. Philos. Soc.*, Vol. IX, 1843, p. 276, Pl. XXXIX, Fig. 3. From Lakes Monroe and George, Florida.

Unio marginis Lea. *Jour. Acad. Nat. Sci. Phila.*, second series, Vol. VI, p. 255, 1868, Pl. XXXI, Fig. 69. From Dougherty County, Georgia. (Pl. II, Figs. 7-9.)

Unio corvinus Lea. *Jour. Acad. Nat. Sci. Phila.*, second series, Vol. VI, 1868, p. 310, Pl. XLVIII, Fig. 123. From Flint River, Georgia, and Neuse River, North Carolina. (Pl. I, Figs. 4-6.)

Unio vesicularis Lea. *Jour. Acad. Nat. Sci. Phila.*, second series, Vol. VIII, 1874, p. 37, Pl. XII, Fig. 34. From Lake Okechobee, Florida. (Pl. V, Figs. 35-37.)

Unio parvus Barnes. *Call, Revision and Synonymy of the Parvus Group of Unionidæ*, *Proc. Ind. Acad. of Sci.* for 1895, pp. 109-119, 1896.

So few of the animals of the *Unionidæ* have been described that it may not be superfluous to give in this place a description of the animal of *Unio parvus* (Pl. 65, Fig. 1), based upon the examination of a fresh specimen from the Des Moines River in Central Iowa.

Color of the mass whitish; tentacular portion of (*b*) mantle dark brown, ending in a caruncle; labial palps (*a*) large, white, triangular, united at base and partially so over the posterior margin; external ctenidium (*e*) smaller than the internal, thicker and larger at the posterior extremity, which is rounded, and on the margin, which is marked by a double row of minute, (*c*) white papillæ; ctenidia united above throughout their entire length, free below; internal ctenidium (*f*) white, ovate.

The mass of the animal within the cavity of the beak is light brown, owing to the color of the large liver, which shows through the thin tissues separating it from the chamber of the ctenidia. Foot (*g*) large, yellowish white.

The chief anatomical peculiarity is the presence of the caruncle (*d*) in the female. This is somewhat separated from the main tentacular mass and is supported by a slender pedicel. Its function is unknown.

To complete the history of this species, the following redescription of the shell of *Unio parvus* is presented, based upon specimens collected in the Wabash River, Indiana:

Shell small, compressed, rather thin, elliptical, rounded anteriorly

and slightly thicker, posteriorly triangulate in the male and occasionally sulcate in the female, thinner; umbonal slope somewhat depressed; umbones rather prominent, with four to five coarse undulations; epidermis thin, olive-green over most of disk, but much lighter on the umbones, striate, especially over the middle disk thence to the margin; in the young two broadening green bands often extend from the umbones over the posterior slope to the posterior margin, otherwise eradiate; ligament small, light brown in color, thin, rather long, but very narrow; hinge teeth small, all double in the left and single in the right valve, the cardinals erect, thin, lamellar, acuminate, crenulate, separating, the laterals long, lamellar, straight, smooth, forming a very obtuse angle with the cardinals; anterior adductor cicatrices distinct, deep, that of the protractor pedis very small; posterior adductor cicatrix scarcely evident, confluent; pallial line distinct for the anterior two-thirds; dorsal cicatrices irregularly grouped in the rather large cavity of the beaks, minute; nacre white, iridescent posteriorly.

	<i>Length.</i>	<i>Height.</i>	<i>Width.</i>	
No. 1.	42.00 mm.	26.00 mm.	23.00 mm.	Female.
No. 2.	36.30 mm.	27.57 mm.	19.25 mm.	Female.
No. 3.	*36.10 mm.	18.00 mm.	14.60 mm.	Male.

UNIO GLANS Lea. Plate 65, figs. 5-7.

Trans. Am. Philos. Soc., Vol. IV, p. 82, Pl. VIII, Fig. 12, 1830; Observations on the *Genus Unio*, Vol. I, p. 92, Pl. VIII Fig. 12. Ohio River.

Unio glans Lea. Call, Revision and Synonymy of the Parvus Group of *Unionidæ*, Proc. Ind. Acad. of Science for 1895, pp. 113-115, 1896.

Unio pullus Conrad. Monography Family *Unionidæ*, pp. 100, 101, Pl. LV, Fig. 2, 1836. Wateree River, South Carolina (Pl. V, Figs. 32-34).

Unio granulatus Lea. Proc. Acad. Nat. Sci. Phila., Vol. XIII, p. 60, 1861. Jour. Acad. Nat. Sci. Phila., Vol. VI, p. 48, Pl. XVI, Fig. 46, 1866; Observations on the *Genus Unio*, Vol. XI, p. 52, Pl. XVI, Fig. 46. Big Prairie Creek, Alabama.

Unio germanus Lea. Proc. Acad. Nat. Sci. Phila., Vol. XIII, p. 40, 1861; Jour. Acad. Nat. Sci. Phila., Vol. VI, p. 49, Pl. XIX, Fig. 54, 1866; Observations on the *Genus Unio*, Vol. XI, p. 53, Pl. XIX, Fig. 54. Coosa River, Alabama.

*This is a large male specimen from the Wabash River, Indiana. In it the cardinal teeth are double in both valves; the posterior cardinal in the left valve is curved dorsad and is very long and thin, its edges are sharply serrate.

Unio cromwellii Lea. Proc. Acad. Nat. Sci. Phila., Vol. XVII, p. 89, 1865; Jour. Acad. Nat. Sci. Phila., Vol. VI, p. 258, Pl. XXXI, Fig. 73, 1868; Observations on the *Genus Unio*, Vol. XII, p. 18, Pl. XXXI, Fig. 73. Kiokee Creek, Albany, Georgia.

Unio cylindrellus Lea. Jour. Acad. Nat. Sci. Phila., Vol. VI, p. 308, Pl. XLVIII, Fig. 121, 1868; Observations on the *Genus Unio*, Vol. XII, p. 68, Pl. XLVIII, Fig. 121. East Tennessee, north Georgia, north Alabama.

Unio corvunculus Lea. Jour. Acad. Nat. Sci. Phila., Vol. VI, p. 314, Pl. L, Fig. 127, 1868; Observations on the *Genus Unio*, Vol. XII, p. 74, Pl. L, Fig. 127. Swamp Creek, Whitfield County, Georgia.

The following conchological description is based upon material taken in the White River, Indiana, where the species attains its maximum development, both in point of size and abundance.

Shell small, elliptical, striate, rather thick and subangulate posteriorly, much thicker anteriorly and rounded; umbones elevated, coarsely undulate, with irregularly crescent-shaped folds, three or four in number; epidermis rather thick, dark greenish, obscurely radiate over the anterior portion of the disk, a character best seen by transmitted light, somewhat polished over the umbonal slope and generally glossy, lighter colored on the umbones; posterior margin sulcate in the female, dorsal portion produced; ligament small, horn-colored, thin; both cardinal and posterior hinge teeth double in the left and single in the right valve, the cardinals short, thick, heavy, serrate; laterals rather long, striate, straight, lamellar; anterior adductor cicatrices distinct, pit-like and deep; posterior adductor cicatrices shallow, confluent, that of the retractor pedis muscle impressed at tip of the laterals and below; pallial cicatrix evident, regularly impressed and linear; dorsal cicatrices several, crowded, in the deep cavity of the umbones or on the margin of the plate joining the hinge teeth; cavity of the umbones rather deep; nacre purple, with anterior margin usually white, whole posterior region beautifully iridescent.

NUMBER.	LENGTH.	HEIGHT.	BREADTH.	SEX.
1.....	34.40 mm.	22.10 mm.	19.51 mm.	Female.
2.....	28.00 mm.	20.00 mm.	16.12 mm.	Female.
3.....	28.50 mm.	20.20 mm.	17.60 mm.	Female.
4.....	37.10 mm.	22.32 mm.	17.24 mm.	Male.
5.....	37.56 mm.	23.44 mm.	18.50 mm.	Male.
6.....	33.00 mm.	21.50 mm.	16.88 mm.	Male.
7.....	30.28 mm.	20.10 mm.	16.50 mm.	Female.
8.....	34.60 mm.	22.92 mm.	17.10 mm.	Male.

Some interesting features connected with the comparative dimensions of the sexes may be shown from this table of measurements. If the two longest males be selected the ratio of length to height is $\frac{37.56}{23.44} = 1.60 +$ and $\frac{37.10}{22.32} = 1.66$. In these same shells the ratio of length to width is as follows: $\frac{37.56}{18.50} = 2.00$ and $\frac{37.10}{17.24} = 2.15$.

A comparison of the same dimensions for the two longest females develops the following ratios: $\frac{34.40}{22.10} = 1.55$ and $\frac{30.28}{20.10} = 1.50$. Comparing the lengths with the widths the ratio established is $\frac{34.40}{19.51} = 1.76 +$ and $\frac{30.28}{16.50} = 1.83$. The ratios show that the females are much wider than the males, a relation probably due to the requirements of the *denidia* of the female shells when functioning as gestatory sacs. So marked, even to casual observation, are these relations that it is an easy matter to select the sexes in any considerable number of shells.

The habits of *Unio glans* are somewhat different from those of *Unio parvus*. It more commonly affects gravelly beds, in shallow running water. The writer has taken the *corvunculus* form in great abundance in the typical locality, whence it was traced into nearly all the streams of north Georgia and Alabama, in the Gulf drainage. The *cylindrellus* form is very abundant in the smaller streams of south Tennessee and in the Black Warrior River of Alabama. The heaviest, largest and *glans*-like forms from the South occur in the Coosa River, a tributary to the Alabama, just above Wetumpka. Similar shells were taken in numbers in the Cahaba River, in Bibb County, also tributary to the Alabama.

These two closely related shells may be easily separated by the color of the epidermis and that of the nacre; also, *parvus* is a much smaller and much thinner shell than *glans*. I have found both species over southern Indiana and in the lakes of the northern part of the State; but the largest, and in all respects finest, specimens I have ever seen were collected near North Manchester, in the Eel River. At this locality, on a small gravelly bar on the river's bank, several hundred large and beautiful examples were collected in 1896. In the White River, near Indianapolis, the species is also common. The following table will enable ready separation of the two forms:

TOPOGRAPHY.	PARVUS.	GLANS.
Outline	Elliptical, somewhat compressed.	Ovate-e'lptical, inflated.
Substance of shell	Thin, slightly thicker before.	Rather thick.
Beaks	Slightly prominent, coarsely and concentrically wrinkled.	Somewhat prominent.
Ligament	Small, thin, light straw-colored.	Small.
Epidermis	Yellowish green, lighter on beaks, striated, lines of growth distant, black.	Black or dark brown, sometimes rayed.
Cardinal teeth	Small, elevated, acuminate, crenulate, double in the left, single in the right valve.	Rather large, elevated, double in left, single in right valve.
Lateral teeth	Slightly curved, long, lamellar.	Straight, lamelliform.
Anterior cicatrices	Distinct, moderately impressed.	Distinct.
Posterior cicatrices	Confluent, slightly impressed.	Confluent.
Dorsal cicatrices	Center of cavity of the beaks.	Center of cavity of the beaks.
Cavity of shell	Shallow, white.	* * * *
Cavity of beak	Shallow, rounded.	Wide, subangulated.
Nacre	White, inclined to salmon, in cavity of beaks.	Purple.
Habitat (original)	Ohio River.	Ohio River.
Width	0.6 inch.	0.7 inch.
Height	0.8 inch.	0.8 inch.
Length	1.6 inch.	1.3 inch,

The coarse undulations on the beaks will aid in separating both shells from *Unio lapillus* Say, which is the only other small *Unio* in Indiana. The complete synonymy is given because it has been carefully worked out and will serve to indicate to Indiana students the work which yet remains to be done on many forms in the State.

UNIO TETRALASMUS Say. Plates 66, 67.

American Conchology, Pl. XXIII, 1830. Described from the Bayou St. John, Louisiana. This plate is copied in Pl. 66 herein, Figs. 4, 5.

Unio declivis Say. Transylvania Journal of Medicine, Vol. IV, 1831, p. 527; American Conchology, Pl. XXXV, 1832; Conrad, Monograph of Unio, p. 45, Pl. XXIII, Fig. 1, 1836. Described from the Bayou Teche, Louisiana.

Unio camptodon Say. American Conchology, 1832, Pl. XLII, Reeve, Conchologia Iconica, Vol. XVI, *Unio* Pl. LXX, Fig. 356, From near New Orleans, Louisiana.

Unio geometricus Lea. Trans. Am. Philos. Soc., Vol. V, 1832, p. 38, Pl. IV, Fig. 10. Described from the Bayou Teche, Louisiana.

Unio exultus Conrad. Monograph of Unio, 1836, pp. 99-100, Pl. LV, Fig. 1. Described from near New Orleans, Louisiana. A copy of this figure is given herewith, Pl. 66, Figs. 1-3.

Unio sayii Ward. So Tappan in Am. Jour. Sci. and Arts, first series, Vol. XXXV, 1839; p. 268, Pl. III, Fig. 1; Conrad, Monograph Pl. LVI, Fig. 2, as *Unio sayanus* Ward. These figures are produced herewith on Pl. 67, Figs. 3-5. Described from Circleville, Ohio.

Unio symmetricus Lea. Trans. Am. Philos. Soc., Vol. X, 1845, p. 73, Pl. IV, Fig. 11. From the Red River, Alexandria, Louisiana.

Unio subcroceus Conrad. Jour. Acad. Nat. Sci. Phila., second series, Vol. II, p. 297, 1854, Pl. XXVI, Fig. 1. Described from a stream in Arkansas, tributary to the Canadian fork of Red River.

Unio manubrius Gould. Proc. Bost. Soc. Nat. Hist., Vol. V, 1855, p. 229. From Chihuahua, Mexico.

Unio jamesianus Lea. Jour. Acad. Nat. Sci. Phila., second series, 1858, Vol. IV, p. 52, Pl. VI, Fig. 35. Described from a single specimen obtained at Jackson, Mississippi, and then in the cabinet of U. P. James, of Cincinnati. The specimen is a pathologic representative of *Unio tetralasmus* Say.

Shell large, rather thick, thicker before, twice or more longer than high, smooth, inflated, polished over the region of the umbones, faintly radiate in young specimens, eradiate in old ones, pointed posteriorly and in general outline narrowly elliptical; epidermis striate, especially near the margins and anteriorly; polished over the lateral umbonal slope, with minute capillary lines impressed but not colored, indicating rays, marked near the ventral margin where they are striate, dark olive-green to horn-color, thin; lines of growth numerous, dark, broad, sometimes almost black; ligament long, narrow, black or dark brown; lunule long, narrow; dorsal margin nearly straight, anterior margin well rounded, ventral margin straight, posterior margin pointed, biangular, slightly emarginate dorsad; anterior umbonal slope well rounded; lateral umbonal slope long, inflated; posterior umbonal slope obtusely angular, imbricated by the lines of growth, subsulcate near the dorsal margin, where are two depressed lines which extend from the beaks to the posterior margin; umbones full, somewhat inflated, approximated, decurved, pointed, angular, with five or six concentrically curved undulations which are concave anteriorly, close together; cardinal teeth suberect, thin, plate-like, directed anteriorly and making a very acute angle with the dorsal margin, double in the left and single in the right valve, striate, placed well anterior to the um-

bones; lateral teeth long, thin, narrow, slightly curved, striate, far removed from the cardinals, no plate connecting them; anterior cicatrices large, deeply impressed, distinct, concentrically striate; posterior cicatrices large, confluent, iridescent; pallial line not at all impressed; dorsal cicatrices in an irregular line, pit-like, in the center of the cavity of the beaks; cavity of the shell large; of the beaks shallow and rounded; nacre dull white, blotched with brown and copper-colored patches.

Length, four and one-half inches; height, two and one-fourth inches; width, one and five-eighths inches.

The specimen described is in the American Museum of Natural History, No. J1525, and is from the Red River, Louisiana.

I have departed from the plan adopted in this catalogue far enough, to give the complete synonymy of this species. The original locality for several forms was, as may be seen above, in Louisiana, or not far away from each other. The shell occurs in the Ohio, at many places along the Indiana shore, and in the Wabash. As seen with us, it is a much smaller shell and is generally greenish yellow and not radiate at all. It used to be a very abundant shell in the canal at Cincinnati, but never attained a size much beyond half that of the southern representatives. The habits of the shell are similar to all those that are mud-loving, and in stations of such sort this species is to be sought. The beaks alone will enable the student to distinguish it from all other Indiana shells; no other one resembles it at all.

SUBGENUS MARGARITANA.

MARGARITANA DELTOIDEA Lea. Plate 68, figs. 4-6.

Shell small, about twice as long as high, compressed transversely, rhomboidal in outline, anterior margin well rounded, posterior margin somewhat biangular, but not a constant character, ventral margin rounded somewhat, dorsal margin arcuate, depressed suddenly just anterior to the beaks; epidermis greenish or bright green, in old specimens darker with oxide of iron stains, with many fine green lines extending from the beaks to the ventral margin and so closely crowded together as to make the entire epidermis appear of a bright green hue, the yellowish rays being simply the uncolored portions of the epidermis, thin; lines of growth numerous, crowded, darker bands marking the places of arrested growth; anterior umbonal slope rounded but somewhat compressed, becoming angulate as the beaks are approached; posterior umbonal slope angular, especially in the female shell, much flattened in the male, somewhat darker than the rest of

the shell because of a broad green ray which extends from the apex to the posterior margin; umbones slightly elevated, coarsely folded, very light-colored, the folds having no definite shape, being much finer in some specimens than in others and differently disposed, but usually inclined to be double; ligament short, thick, light horn-color; lunule small, membranaceous; cardinal teeth rather large, erect, double in the right and single in the left valve, placed almost directly under the tip of the beaks; lateral teeth wanting, but an occasional specimen with a single lateral fold, which is suggestive of a lateral tooth; anterior adductor muscular impressions distinct, deeply excavated, occasionally a specimen is found in which they are confluent; posterior cicatrices confluent, very slightly impressed, very iridescent; dorsal cicatrices pit-like, minute, placed in the cavity of the umbones; pallial cicatrix faintly impressed; cavity of the shell small, of the umbones very shallow; nacre white, with a tendency to bluish.

Length, one and one-half inches; height, about one inch; diameter, from one-half to five-eighths of an inch.

This species is widely spread over Indiana, specimens having been seen from the Ohio, Wabash and White Rivers, from Lake Maxinkuckee, from the canal at Brookville, and from the Eel River at North Manchester. It is easily recognized, since there is no other shell in the State which at all resembles it. The male is much larger, flatter, and less rhomboid than the female. The female is characterized by the great angularity of the posterior slope and its generally inflated form. Dr. Lea has described this species, which originally came from the Ohio at Cincinnati, under the name of *Unio calceolus*, which was the female form and came from the indefinite locality "Ohio." The species is very common, and when one specimen is taken many others are sure to be found near by.

MARGARITANA CONFRIGOSA Say. Plate 69.

Shell rather thick, thicker anteriorly, heavy, oval in outline, plicate, tuberculate, almost spinous on the umbones; epidermis black in old, dark olive-green in young specimens, eradiate, striate, glossy; lines of growth strong, crowded, raised, imbricated posteriorly; dorsal margin curved, thickened; anterior margin well rounded, forming a pronounced angle with the dorsal margin; ventral margin rounded; posterior margin biangulate, irregular; umbonal slope full but flattened transversely, somewhat rounded anteriorly, obtusely angular posteriorly, with a number of coarse parallel folds, which, beginning as small folds on the disk of the shell, sweep downwards and backwards, then upwards to the posterior margin; the disk of the valves with

numerous folds, coarse or fine, sometimes approaching tubercles, arranged without definite order or position, disappearing towards the anterior part of the shell; umbones raised, very prominent, lighter colored than the rest of the disk, with four to six large tubercles, arranged in two rows which diverge, the lower ones largest, often taking the appearance of short, thick spines, the beaks approximated, decurved, very light; ligament long, narrow, thick; dark horn-colored; lunule long, narrow, membranaceous; cardinal teeth double in the left and single in the right valve, thick, rather heavy, occasionally disposed to be trifold in the left and double in the right valve; lateral teeth wanting, but often a sharp ridge or fold extends well towards the posterior margin from near the umbones; anterior cicatrices well impressed, concentrically striate, distinct; posterior cicatrices confluent, very slightly impressed; dorsal cicatrices on the outside of the plate formed by the cardinals; pallial cicatrix very faintly impressed; cavity of the shell large, of the beaks very small; nacre white, very iridescent posteriorly, sometimes with a decided purplish tinge on the posterior margin, the cavity of the beaks often a dirty yellow.

Length, three to four inches; height, two and one-half to three inches; transverse diameter, one and one-half inches, sometimes a little more. There is little noticeable difference in the sexes.

This species is common in the Wabash, but has been seen from no other locality in this State. It is one of the rarer forms, and is restricted in distribution in about the same manner as is *Anodonta suborbiculata*. It is one of the most remarkable species of the American fresh-water shell fauna, and is not a very variable shell; the variations are mainly in the character and number of the tubercles which mark this shell and serve to easily separate it from all others. In the very young shells the tubercles are inordinately large for the balance of the shell, and give it a very spinous appearance. In later life this disparity becomes less obvious. Specimens are sometimes found which are larger than indicated by the above dimensions, but these are the average sizes. The habitat of the shell is in deep water, in muddy bottoms; it was originally described from the Wabash.

MARGARITANA MARGINATA Say. Plate 70.

Shell somewhat thick, scarcely thicker before, rudely quadrangular in outline, swollen posteriorly, cuneate or wedge-shaped anteriorly, little more than twice longer than high; epidermis light yellowish or straw-colored, much lighter on the umbones, thin, brilliantly rayed with numerous bright, green lines which extend, becoming broader, from the middle of the umbonal slope to the margin below, curving

anteriorly in the anterior half of the shell, all the posterior dorsal slope usually eradiate, polished; lines of growth broad, darker, extending well forward before curving towards the dorsal margin; dorsal margin curved, slightly thickened, forming an obtuse angle with the anterior margin, which is sharply rounded; ventral margin commonly emarginate; ventral margin rounded in a flowing curve from the dorsal margin to near the ventral border, where it is suddenly and sharply biangulate, gaping in the region of the siphons; lateral umbonal slope flattened, anterior slope rounded, becoming subangulate near the beaks, posterior umbonal slope angular, sharply so, flattened transversely, giving the shell a triangular appearance when viewed from the posterior imbricated by the coarse lines of growth, with numerous minute folds which cross the lines of growth at right angles; umbones prominent, light-colored, with three to four large and coarse wavy folds, beaks approximated, decurved; ligament rather long, thick, wide, and dark horn-colored; lunule long and narrow, lighter colored; cardinals disposed to be double in the left valve, always single in the right, rather small, lamellar, erect; laterals wanting; anterior adductors fairly well impressed, rather small, the portion occupied by the anterior retractor pedis very deep or pit-like; posterior cicatrices slightly impressed, confluent; pallial impression not visible; dorsal cicatrices minute, pit-like, in the center of cavity of the beaks; cavity of the shell large, of the beaks rather deep and wide; nacre bluish white, with white bands which mark the position of the lines of growth, not remarkably iridescent, often a dull white.

Length, three and one-half inches; height, one and one-half inches; width, male, one inch, female, one and one-fourth inches.

This form occurs in every river basin in Indiana and is often found in lakes and ponds. It is, in its markings and general outline, very much like *Unio triangularis* Barnes, but the absence of lateral teeth will immediately separate it from that species. The animal is very active, and it is often to be noticed crawling over the gravelly bars, which it commonly inhabits. It is a beautiful species. The animal is light salmon-colored, with a large and tough foot; indeed, the foot seems to make up most of the animal. I have taken it in numbers in the Ohio and Eel rivers, and usually find it difficult to remove it from its bed when anchored on a gravel bar with its long and strong foot fully extended.

MARGARITANA COMPLANATA Barnes. Plate 71.

Shell large, thick, thicker anteriorly, alate, greatly compressed transversely, generally circular in outline when the ala is intact,

broadly and faintly plicated in old specimens on the interior portion of the ala; epidermis dark horn-color, reddish brown on the disk, where it is glossy, striate near the margins, imbricated posteriorly, with occasional broad bands of greenish parallel with the growth lines, much lighter on the beaks, at times silvery white at the apex; lines of growth broad, distinct, crowded, especially towards the ventral and posterior margins; dorsal margin much curved; anterior margin rounded, forming a very obtuse angle with the dorsal margin; ventral margin slightly rounded; posterior margin biangulate, the dorsal portion straight; umbonal slopes scarcely raised, flattened, the posterior with three more or less well-marked carinæ which extend from near the region of the beaks to the posterior margin, ending at the siphonal openings and marking their position; umbones not at all elevated, on a level with the dorsal margin with three or four coarse, large, wavy folds; ligament long, thick, dark brown in color, in perfect specimens completely covered by the portion of the shell which forms the ala; lunule long, narrow, pointed at both extremities; cardinal teeth large, heavy, flattened, rather smooth, disposed to be trifid in the left and double in the right valve, often roughened by disease; laterals wanting but their position sometimes indicated by a sharp, raised ridge or carinæ on which are sometimes three to five low and rounded ridges extending posteriorly; anterior adductors large, deeply impressed, the cicatrix of the anterior retractor pedis being confluent with that of the adductor but deeply impressed behind it about the middle, the impression of the protractor pedis distinct, large, irregular; the posterior muscular impressions very faint, confluent; the dorsal cicatrices placed on the outside of the plate formed by the cardinal teeth, pit-like, deep, thence forming a short row into the cavity of the beaks; pallial cicatrix well impressed anteriorly, crenulated; cavity of the shell large, of the beaks very shallow; nacre white, scarcely any iridescence, with numerous large and small copper-colored blotches irregularly disposed over the entire interior.

Length, seven to eight inches; height, five and one-half to six inches; diameter, one and three-fourths inches. I have seen larger examples but these are the sizes for large examples which are common.

This species occurs in the Wabash, Ohio, White, Kankakee, Eel and other rivers. It frequents muddy bottoms and has much the habits of *Anodonta*. The foot is very large and powerful, like all of the genus, and when the animal is anchored in the mud is pulled out only with difficulty. It is the only alate *Margaritana* in Indiana and is therefore easily recognized. The specimen figured is a young example.

This species was described by Mr. Barnes in 1823 and the types came from the Fox River, Wisconsin. The description was published in the American Journal of Science, Vol. VI, pp. 278-279, and rudely figured on Pl. 13, fig. 22. Since this original description may be of interest, and it is now difficult to find access to this old publication, I give it below:

"Shell very short behind; disks much flattened; umbones depressed; beaks slightly projecting; ligament between the valves; anterior lunule much compressed and folded across the transverse wrinkles; hinge margin elevated into a large wing, straight and forming an obtuse angle with the posterior dorsal margin; basal margin slightly rounded, nearly straight; anterior and posterior margins somewhat angulated; anterior dorsal margin arcuated, or somewhat emarginate; epidermis chestnut brown, glossy; surface somewhat deeply wrinkled and striated transversely; slightly elevated ridges and furrows diverging from the beaks to the anterior margin, and distinctly impressing the inside. Teeth elevated, sulcated and radiating from the beaks; cicatrices smooth; cavity small and angular; nacre bluish white and iridescent; surface smooth, and polished, in old specimens spotted with green."

"Remarks.—This shell resembles the *Unio alatus*, in the elevation of the wing and the connexion of the valves, and might at first sight be mistaken for a variety of that species; but it differs in generic character, in shape, and in colour." (Barnes.)

MARGARITANA RUGOSA Barnes Plate 72.

Shell large, thick, heavy, scarcely thinner posteriorly, elongated, twice longer than high, compressed on the middle umbonal slope; epidermis dark horn-color to reddish, with numerous fine, green, parallel rays extending from the umbones to the ventral margin, over the middle third of the disk, striate, shining on the umbonal slope, darker posteriorly, especially towards the dorsal margin, rather thick, much lighter to white on the beaks, grayish for some distance below them; lines of growth very numerous, often raised into low rounded ridges, crowded anteriorly and imbricated posteriorly; dorsal margin nearly straight, anterior margin well rounded, ventral margin straight, posterior margins biangulate, in some specimens decurved below the ventral margin; anterior umbonal slope flattened, posterior umbonal slope much wrinkled, with coarse folds, these being usually more marked in the young specimen, obtusely angular from the beaks to the posterior border where it meets the ventral border; umbones scarcely raised above the dorsal margin, small, directed anteriorly, with

from three to four coarse, sometimes double or wavy folds, covered with a very light epidermis; ligament long, thick, broad, black; lunule linear, long, membranaceous; cardinals disposed to be double in the left, single in the right valve, erect, large, thick, smooth, sometimes with many deep but narrow furrows which radiate from the direction of the umbones; laterals none, their place being indicated by a thick, rounded fold on the posterior portion of the dorsal margin just below it, sometimes showing a slight tendency to become double; anterior muscular scars deeply impressed, large, distinct, the posterior confluent, well impressed, usually iridescent; dorsal cicatrices numerous, small, pit-like on the plate of the cardinal tooth; pallial impression marked, deepest anteriorly, crenulated; cavity of the shell narrow but large, of the beaks very round and shallow; nacre white, bluish-white, or occasionally a pinkish or salmon tinge, not very iridescent.

Specimens are often six and one-half inches in length, and proportionately high; the females are a little more obese than the males.

This shell is found in every large stream and most of the smaller ones in Indiana. It is very common and very large in the Mississippi at Moline, Illinois, but the Ohio River specimens outrival them. Among the largest which I have collected in this State are a fine series from the Eel River, at North Manchester. These were found on a long gravel bar near the midstream and were deeply buried in the gravel, the broad, long and strong foot being thrust far down in the bottom. The animal is uniformly a dull salmon or yellow color, and quite fills the shell, the foot constituting the major portion of the soft parts.

This shell was originally described from the Fox River, Wisconsin, by Mr. Barnes, in the American Journal of Science, first series, Vol. VI, p. 278, and was figured on Pl. XV, fig. 21, 1823. For the same reasons that were given in the case of *Margaritana complanata* I append the original description, copied, and trust it will prove of historic use:

“Shell oblong-oval, about equally broad before and behind; beaks slightly elevated, wrinkled and decorticated, exhibiting a wax colour beneath; ligament external and as high as the beaks; anterior lunule distinct with a slightly elevated ridge extending from the beaks to the ant. basal margin; basal margin a little shortened; the other margins regularly rounded; epidermis chestnut brown, with a silky lustre; surface of the anterior part folded in a pinnate form; folds deeper above and somewhat obsolete below the ridge, curved upward and extending to the hinge and anterior margins, indenting the edge and visible on the interior. Teeth large and elevated with a fold

behind; cicatrices smooth; cavity small; naker pale flesh coloured in the center, pearly white on the margin with a narrow border of dark chocolate colour; surface smooth and glabrous." (Barnes.)

All the species of *Margaritana* are so distinct, as exhibited in this State, that there is no need of an artificial key to aid in their identification. Only a single other species is known besides this one that could be mistaken for it, from the size, and that is *M. complanata*, which is entirely dissimilar in outline and markings. Both are large shells and both are thick shells, but there the resemblance ends.

MARGARITANA MONODONTA Say. Not figured.

Shell oblong, three and one-half times longer than high, arcuate, rather thin posteriorly, thicker anteriorly, compressed transversely; epidermis black, thick, sometimes brownish-black, a little lighter on the umbones, eradiate in old specimens, the young not seen; lines of growth numerous, well marked, imbricated posteriorly, much crowded; dorsal margin somewhat curved, thickened, rounded, anterior margin well rounded, making an obtuse angle with the dorsal margin at point of junction, ventral margin very much arched, posterior margin rounded and slightly decurved; umbonal slope compressed anteriorly, not very evident, posteriorly somewhat inflated and subangular, with an obtuse angle extending from the umbones to the postero-ventral margin; ligament long, thick, black; umbones small, not much elevated, generally decorticated, approximated, with a few very fine folds, which are scarcely visible in middle-aged shells with perfect epidermis; cardinal teeth small, erect, thin, double in the left and single in the right valve; laterals none; anterior muscular impressions distinct, well impressed, large, sometimes roughened; posterior muscular impressions confluent, slightly impressed; cavity of the shell small, of the beaks very shallow; nacre whitish, sometimes purplish, especially in the region of the umbones, the anterior, ventral and posterior margin of the nacre is very thin and the epidermis shows through as a narrow border of dark purple, iridescent.

This species was described from the Falls of the Ohio, at Louisville, whence I have taken very large examples. I have seen specimens from the Wabash, but all agree in all the essential characters. The habits of the animal render it difficult to find and it is not common in even good collections. It buries itself far down in the gravel and mud, on the falls, under large flat rocks where water circulates freely, or alongside submerged timbers which are well buried in the mud of the river bottom. The foot is long, slender, but very powerful and serves to anchor the animal firmly in even the swift waters of the falls. Its

anatomy is worthy of special research; nor are all its habits known. A single dead shell was found on a river bar in the Ohio, at Lawrenceburg.

This species is sometimes seen in collections under the name of *Margaritana margaritifera* Linnæus, a circumpolar species, to which it has a close general resemblance. But the Linnæan form does not occur in Indiana. The only shell with which it is likely to be confounded, from its color and generally long shape, is *Unio rectus*, but the lateral teeth of that species will separate it easily. *Unio rectus* is also a much thicker shell, much heavier, more pointed, and has a highly polished epidermis, which is rayed.

MARGARITANA HILDRETHIANA Lea. Not figured

Shell narrow-elliptical, subcylindrical, very transverse, inequilateral, somewhat compressed at basal margin; substance of shell thin behind, thicker before; beaks slightly elevated; ligament long and thin; epidermis dark brown; cardinal teeth lobed, single in each valve, larger and wider in the left valve; lateral teeth none; anterior and posterior cicatrices both confluent; dorsal cicatrices in the center of the cavity of the beaks, shallow, and tinged with dull purple; nacre white and iridescent. (Lea.)

I have not been able to secure a specimen of this shell for redescription though it is very common indeed; so I am obliged to copy Lea's very incomplete original description. Many hundreds of this species have passed through my hands in the past twenty-five years and all present the same characters. The shell does not vary much. Lea described it as *Unio hildrethianus* but afterwards placed it in *Margaritana* where it certainly belongs. Recently some wonderful attempts have been made to locate this shell in a section with *Unio* and possibly making it the type of a new genus! The animal has all the characters of the ordinary *Margaritana*, and no violence is done to natural classification by letting it alone since it is in natural company. The habits are somewhat peculiar; it is sometimes found in mud and on gravel bars, but in greatest numbers and perfection hidden in the mud under flat stones; more than two hundred have been taken from under a single flat rock of about one square foot area.

It is known from the White, Wabash and Ohio rivers in Indiana, but has yet to be found elsewhere in this State.

ANODONTA IMBECILLIS Say. Plate 73.

Shell thin, rather small, two and a half times longer than high, scarcely thickened anteriorly, rounded before, biangulate behind;

epidermis greenish-yellow, with well-marked bright green zones, indistinctly rayed, with two to three green lines, becoming broader and extending from the posterior region of the umbones along the posterior umbonal slope to the posterior margin, terminating at the siphonal openings; epidermis thin throughout; lines of growth distant, distinct, broad and much darker than balance of epidermis, sometimes well impressed, giving the shell a roughened character; dorsal margin straight, ventral margin slightly curved, with a slight swelling near posterior border; anterior umbonal slope compressed, not well marked, posterior umbonal slope rounded, full, then narrowing to the margin; umbones very much depressed, on a level with the dorsal margin, minutely and concentrically plicate, the folds being exceedingly fine, silvery; ligament long, narrow, thin, light corneous, scarcely raised above the margin; lunule none; teeth of hinge joint entirely wanting; anterior adductors slightly impressed, distinct, that of the protractor pedis not evident; posterior impressions confluent, not at all impressed, but wrinkled and iridescent; pallial impression scarcely showing; cavity of the shell shallow, but large; nacre bluish-white, with many bluish zones which mark the positions of the external lines of growth.

Length, two to three inches; height, one and one-fourth inches; diameter, three-fourths of an inch.

This fragile species is the most brilliantly colored of any member of the genus; it is very common in the Ohio, Wabash, White and Blue rivers; it is also found in several small streams, as in Bennett's Creek, Vigo County. It will ultimately be found all over the State. It can not be confounded with any other Indiana shell, its extreme fragility, brilliant coloration and slender outline serving to separate it.

ANODONTA WARDIANA Lea. Plate 74.

Shell rather thin, thicker anteriorly, about twice longer than high, well rounded before, obtusely biangulate behind; epidermis light yellowish to dark horn-color, with numerous wavy, narrow or broad green lines extending from the umbones to the posterior and ventral margins, the shell having the appearance, in some specimens, of being green, with light yellow color lines, epidermis rather thick, smooth, shining or polished; lines of growth numerous, distinct, darker, slightly raised; dorsal margin slightly curved, usually slightly thickened anterior to the beaks, giving a faint suggestion of a cardinal tooth, ventral margin straight, sometimes slightly emarginate towards the posterior end, anterior margin well rounded; anterior umbonal slope well marked, full, rounded, posterior umbonal slope full,

rounded or subangular, with one or two faint carinæ extending nearly to the posterior border; umbones triangular, raised, full, prominent, with four large and coarse undulations which are lighter than the balance of umbones, the entire epidermis of which is silvery whitish; ligament short, thin, narrow, dark brown in color; lunule long, narrow, chitinous; internal dorsal margin curved, thickened anteriorly so as to almost form a single cardinal tooth (a character not equally marked in all specimens); anterior cicatrices distinct, not deeply impressed, roughened, very large; posterior cicatrices distinct, well impressed, iridescent; cavity of the shell capacious, of the umbones shallow; nacre white or bluish white, smooth, not very iridescent, growth lines showing as thickened and whiter zones parallel to the ventral margin. The pallial line is faintly impressed and is distinctly crenulate.

Length, three to three and a half inches; height, one and one-half inches; width, one and one-fourth inches.

This species occurs in the White and Blue rivers, and in smaller streams in the northern part of the State. It is synonymous with *Anodonta pavonia* Lea, which I have formerly listed under that name from Indiana, but there can be no doubt of their identity. The last named is rather more brilliantly rayed than *wardiana*, but differs in no other respect. This species is quite close to the type of the group, herein described under the name of *Anodonta edentula* Say. The wavy character of the green color lines and the bright yellow epidermis which shows between them will enable this form to be readily identified. It is abundant where found at all.

ANODONTA EDENTULA Say. Plate 75.

Shell thin, thicker anteriorly, twice as long as high, produced and rounded anteriorly, posterior margin slightly emarginate, biangular; epidermis fuscous, lighter on the umbones, the posterior two-thirds closely and finely rayed, the rays being wavy, often thread-like, sometimes very broad, dark olive in color, epidermis striate near the inferior border; lines of growth distinct, dark, slightly raised; dorsal margin nearly straight, thickened in the region of the beaks, round, smooth, straight posterior to beaks, thickened, or somewhat dentate anterior to the beaks, declined; ventral margin straight; anterior umbonal slope rounded, full, subangular towards the beaks, posterior umbonal slope subangular, full, with one or two slightly depressed, hair-like lines extending from beak to margin in region of siphonal openings; umbones prominent, raised, biangulate, nearly or quite touching, with three to four coarse folds, covered with a grayish white

epidermis when perfect; ligament short, broad, dark horn-color, somewhat raised above the dorsal margin; lunule long, narrow, membranaceous; anterior muscular cicatrices confluent, well impressed, irregular in outline, that of the protractor pedis being large and crenulate; posterior cicatrices confluent, distinctly impressed, that of the retractor pedis at extreme end of dorsal marginal plate; pallial impression scarcely visible; cavity of the shell capacious, of the umbones shallow; nacre white, bluish-white or with a faint tinge of salmon, iridescent posteriorly.

This species is common over all of Indiana, specimens having been seen from all the large rivers and from many of the small streams and lakes. In the Ohio it is the most common *Anodon*. It has a wide range of variation, the forms from the lakes being smaller, thicker, darker in color, and less beautifully rayed. The species has a wide range over the eastern United States, and as far west as Kansas and Nebraska, and has a very large synonymy. Two of these, *Anodonta ferruginea* and *Anodonta shaffneriana*, have been reported from this State, but those names are now retained only by conchological tyros who desire to have a large exchange list to entice the unwary. Unlike many of its fellows, this species has no particular habitat, frequenting muddy and gravelly as well as rocky bottoms alike.

ANODONTA SUBCYLINDRACEA Lea. Plate 76.

Shell thin, scarcely thicker anteriorly, two and one-half times longer than high, outline somewhat resembling a rude parallelogram, rounded before, somewhat angulate behind, the male being markedly angular posteriorly, and pointed; epidermis light-corneous, with greenish tinge in broad bands parallel to the lines of growth, over the umbonal slope much lighter, often copper-colored, especially at tips of beaks, sometimes silvery, with numerous bright green rays sweeping in flowing curves towards the posterior margin from the middle of the umbonal slope, often not apparent except near the ventral margin, epidermis thin; lines of growth distinct, broad, dark-colored, widely separated; dorsal margin straight, thin, ventral margin sinuous in the female, or emarginate, the male with ventral margin straight, both sub-angular anteriorly; anterior umbonal slope full, much rounded, slightly compressed in the male, posterior umbonal slope full, rounded, with three green color lines extending from the beaks to the posterior margin, becoming broader and marking the positions of the siphonal openings; umbones flattened, full, light-colored, the beaks nearly touching, with three small folds or crenulations near their tips, which are decurved; ligament rather long, light horn-color or light brown,

thin, slightly raised above the dorsal margin; lunule none; both the anterior and posterior muscular impressions scarcely visible, so faintly are they impressed, confluent; cavity of the shell deep, of the umbones very shallow; nacre white, beautifully iridescent posteriorly.

Length, three and one-half inches; height, one and one-half inches; width, one and one-eighth inches.

Specimens of which the dimensions are given are the largest of those used in the description and are by no means to be taken as the greatest dimensions attained. This species is often taken with much larger dimensions than those given. It is found in the Ohio River, the Wabash, the White, and in numerous lakes in northern Indiana. A synonym of this species which occurs in many Indiana localities is *Anodonta ferussaciana* Lea, a species which we have reported from several localities within the State. The cylindrical form of this shell, its greenish tinge, its recurved and neatly folded beaks, will serve to separate it from all other shells.

ANODONTA GRANDIS Say. Plate 77.

Shell large, very thin, of uniform texture throughout, broadly oval in outline, rounded before, pointed posteriorly, and biangulate; epidermis light horn-colored in young and in half-grown specimens, darker in the maturer forms, polished over the umbones, striate at the posterior and ventral margins; lines of growth coarse, broad, darker-colored, slightly raised, coarsely crowded on the posterior umbonal slopes, where they are imbricated and give the shell a rough appearance; dorsal margin slightly curved, anterior margin rounded, with a decided angle at juncture with dorsal margin, ventral margin well rounded, posterior margin biangulate, nearly straight to the dorsal margin from the siphonal openings; anterior umbonal slope full, rounded; posterior umbonal slope rounded or subangular, darker-colored, with two or three faint, broad, and darker color bands extending from the beaks to the posterior margin, sometimes so wide as to cover the whole of this portion of the shell and then very dark olive or black in color; umbones somewhat raised, but not especially high, in perfect old and in young specimens copper-colored, the beaks being approximated, decurved, with a double row of fine, curved folds, which are much like to flattened U's joined together, four or five such folds being concentrically arranged; ligament long, thin, black, narrow, not raised above the dorsal margin; lunule none; adductors scarcely visible and lightly impressed, the protractor and retractor pedis muscles being confluent with the adductors, though occasional specimens are seen with the anterior adductors distinct; cavity of the shell very large,

of the beaks shallow; nacre white, salmon-colored or copper-colored, often with darker brownish or copper-colored patches, especially in the regions of the umbones; the growth lines are marked on the inside of the shell by raised whitish lines indicating thicker deposits of nacreous matter.

Length, seven inches; height, five inches; width, three inches, and in occasional globose specimens more.

This is the largest *Anodon* in the State, and is exceedingly abundant in ponds along the Ohio and the Wabash rivers. It occurs, also, in the rivers of the northwestern part of the State and delights in sluggishly flowing streams and muddy ponds. It is a very variable shell, both in respect to its outline and its coloration. Many synonyms have been made of its various forms; of these the following are found in Indiana: *Anodonta decora*, *Anodonta plana*, and a form which Mr. Lea described under the name of *Anodonta gigantea* from the southern States. In any considerable number of individuals it is possible to pick out forms which fit exactly Lea's descriptions. The colors of the epidermis and the nacre seem to depend on the ponds in which the animal lives; sometimes the whole epidermis is beautifully rayed with greenish lines, in other specimens a dark olive will predominate, with shining epidermis and faint color lines or none at all, while in still other individuals the rays are entirely wanting and the epidermis is light green or yellowish in color.

ANODONTA SUBORBICULATA Say. Plate 78.

Shell very large, thin, round in outline, compressed transversely, substance of the shell rather thin, subbiangular anteriorly, sinuously biangular behind; epidermis dark horn-colored, polished, shining, eradiate, thin, lines of growth conspicuous, numerous, black, concentric, raised; imbricated on the posterior dorsal slope, which is sulcate; dorsal margin curved; ventral margin well rounded, in a regularly flowing curve, anterior margin well rounded; anterior umbonal slope not much raised, or depressed, inconspicuous; posterior slope roundly angular, with a decided sulcus near the dorsal margin which extends to the upper limit of the siphonal openings, shell gaping at the siphons; beaks scarcely raised above the dorsal margin, with a number of minute apiculations near the apex; ligament long, broad, thick, black; lunule none; anterior muscular impressions distinct, slightly impressed, roughened; posterior impressions confluent, very slightly impressed; pallial line sinuous and very faintly impressed; cavity of the shell very large, that of the beaks very shallow; nacre light salmon-color, very iridescent, with thickenings of nacreous matter marking

the position of the external lines of growth, occasionally roughened by disease, especially in the region of the adductors.

This species is limited in its distribution in this State to the Wabash River and the ponds along its course. In muddy bayous and the small lakes left by the changing of the river's course this species may be found. It is not a species of wide distribution, having been found only in a zone which extends westward to the Mississippi at Muscatine from the Wabash River in Indiana. Its peculiarly round outline and large size will enable one to easily separate it from all other Indiana forms. Its anatomy is unknown.

Specimens have been taken which were seven and one-half inches in length, five and three-fourths inches in height, and two and one-half inches in diameter.

ANODONTA DEHISCENS Say. Plate 68, figs. 1-3.

Shell thin, slightly thickened anteriorly, trapezoidal in outline, rounded before, and rather sharp pointed behind; the dorsal margin oblique, but straight, ventral margin slightly emarginate, posterior margin pointed and wavy, the shell gaping at posterior and anterior regions; epidermis dark brown or fuscous, sometimes approaching dark olive, polished, beautifully rayed with dark green lines which extend from the beaks to the ventral margin, being directed posteriorly, and are straight, becoming regularly broader as the ventral margin is approached; lines of growth broad, black, raised; dorsal hinge margin very obtusely angular, from beaks to posterior margin straight, scarcely thickened; anterior umbonal slope flattened, posterior umbonal slope subangular, black, with a number of small folds, which are almost inconspicuous and make an angle with the lines of growth; beaks minute, depressed, scarcely folded, the embryonic shell being retained in perfection, sometimes with a couple of rather coarse, depressed folds; ligament long, thin, black; anterior muscular impressions separate, faint, irregular, often roughened; posterior cicatrices rather deeply impressed, confluent, the pallial impression very wavy, slightly impressed, deeper anteriorly; dorsal cicatrices in the cavity of the beaks large and pit-like; cavity of the shell not large, of the beaks scarcely deeper than that of the body of the shell; nacre bluish, with many specimens purplish in the region of the umbones, very iridescent posteriorly.

This species rarely attains a length greater than three and one-half inches; a height of one and one-fourth inches; and a diameter of five-eighths of an inch. It occurs in the Ohio and Wabash rivers, but I have seen it from no other portion of Indiana. It is a rare species,

whose habits tend to keep it unknown; it buries itself deeply in the mud and gravel of bars, and rarely crawls about like most of the *Unionidæ*. Its highly polished epidermis and characteristic rays will distinguish it at once.

This shell has usually been placed in *Margaritana*, and one writer, Dr. Lea, placed it in *Unio*, describing it under the name of *Unio oriens*. The entire absence of teeth on the dorsal margin must compel its reference to *Anodonta* as now understood. In the gaping character of its shell it differs from all others of the *Unionidæ*; it is aberrant in other particulars, and would seem to invite the careful study of those who are situated so as to observe it in its habitat.

ANODONTA SALMONIA Lea. Not figured.

Shell thin, twice as long as high, slightly thickened anteriorly, elongately oval in outline; epidermis fuscous, generally eradiate, or but faintly rayed on the posterior slope, polished, with sometimes a broad band of greenish concentric with the base or ventral margin, striate near the margins all around; lines of growth inconspicuous, darker than the epidermis, imbricated on the posterior dorsal slope; dorsal margin nearly straight, anterior margin well rounded, posterior margin somewhat pointed, and biangulate; both umbonal slopes rounded, that of the posterior more full, marked by two or three broad, greenish, increasing bands or lines from beaks to posterior margin; umbones somewhat raised above the dorsal line, copper-colored, lighter than the balance of the shell, beaks approximating, small, with three rather coarse folds or wrinkles near the apex which sometimes appear double, being made up of a low and wide W; ligament long, thick, light-brown, slightly raised above the dorsal margin; anterior cicatrices distinct, not deeply impressed; posterior cicatrices very faintly impressed, confluent; dorsal cicatrices pit-like, situated in the cavity of the beaks or just anterior; cavity of the shell large, of the beaks shallow; nacre bluish white on the margins but brilliantly salmon-color and very rough in the cavity of the shell and in the region of the attachment of the anterior adductors, sometimes reddish or yellow, giving the shell a diseased appearance.

This species is common in the White River, in the upper waters of the Wabash, and is occasionally taken in the Ohio. It is a mud-loving form. The pinkish character of the umbones near the apex, after the epidermis is worn off, and the thick, rough deposit of salmon-colored nacreous matter over the interior of the shell will alone serve to separate it from all others. The species belongs to the *grandis* group, and has much the shape of a half-matured form of that species, includ-

ing even the epidermal colorings. It is, however, a distinct species. The single specimen before me, from which the description is drawn, came to hand without locality, and that important item can not be furnished. The species is so characteristic that it does not need to be figured.

ANODONTA FOOTIANA Lea. Not figured.

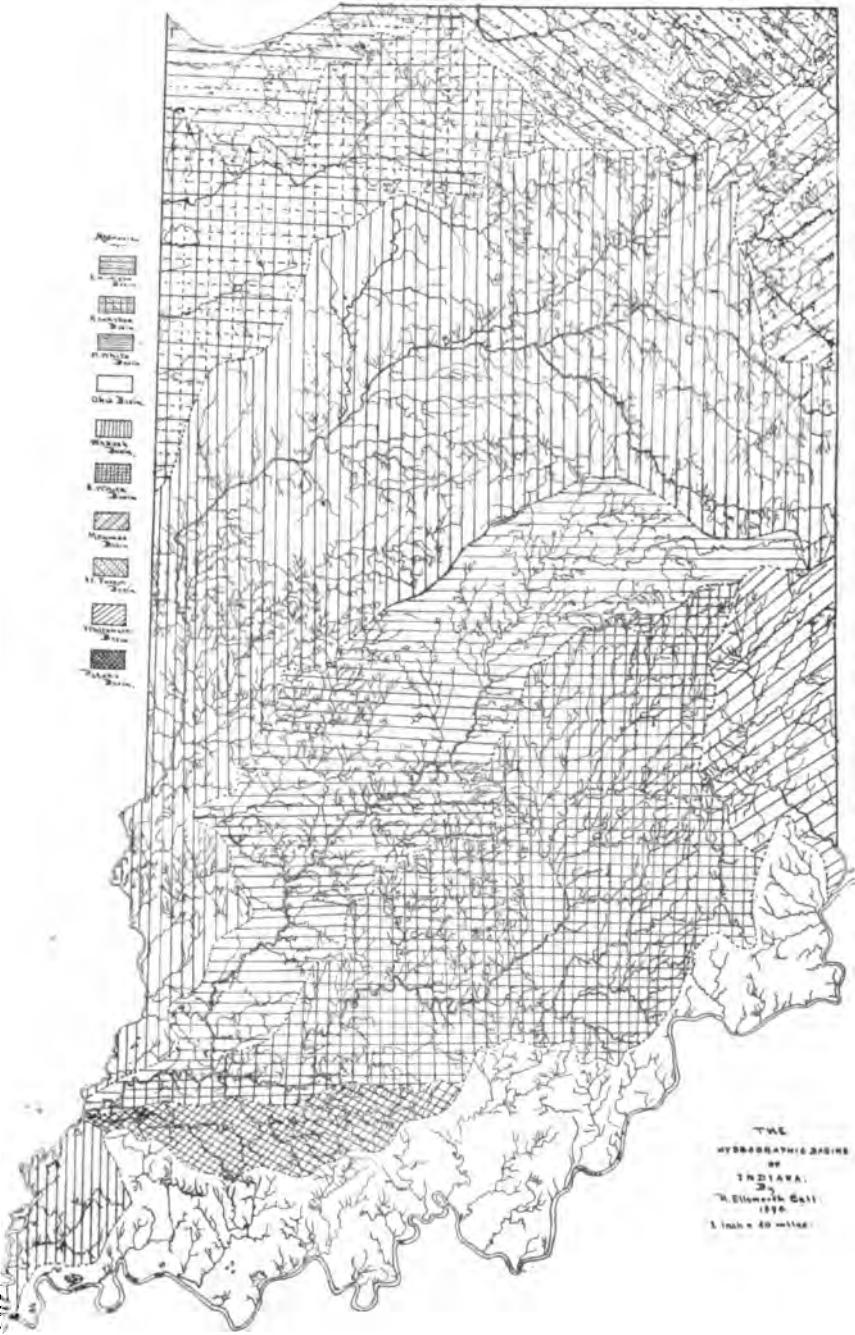
Shell thin, fragile, twice longer than high, narrowly elliptical in outline, smooth, polished on the umbonal slopes, striate near the margins, somewhat inflated, eradiate, (young specimens are sometimes rayed on the umbonal slopes); epidermis dark horn-color, or greenish yellow, thin, much overlapping the shell proper at the anterior and ventral margins, occasional impressed lines, capillary, taking the place of rays; anterior umbonal slope full and rounded; lateral umbonal slope inflated, long; posterior umbonal slope rounded angular; umbones somewhat elevated, pointed, triangular, with three to four minute apiculations, arranged in two rows and usually eroded away, beaks placed about one-third of the length of the shell from the anterior extremity; dorsal margin somewhat arcuate, anterior margin well rounded, forming an obtuse angle with the dorsal margin, ventral margin straight, posterior margin biangulate, compressed towards the ligament; anterior cicatrices confluent, scarcely impressed; posterior cicatrices large, not at all impressed; dorsal cicatrices small, in the center of the cavity of the beaks; pallial line not at all evident; naere bluish white, with brownish or copper-colored patches, in specimens which are nearly eroded through in the region of the beaks the naere is reddish to brownish and gives to the shell a diseased appearance; ligament, long, thin, light brown; lunule none; lines of growth prominent and darker than the rest of the epidermis.

Length, three and one-half to five inches; height, from one and seven-eighths to two and one-fourth inches.

The specimen described is from Ohio, and is No. H2039 of the collections of the American Museum of Natural History, loaned for this purpose by Professor R. P. Whitfield.

This shell is very common in the lakes of northern Indiana and in the larger streams of the northern third of the State. It is very fragile, and often breaks into pieces through the changing temperatures of the cabinet. It has no near relative in the State and needs no special mention; the lake forms are usually much eroded, and the shells are reddish in color from the iron oxide in the mud in which they dwell. At Winona Park the form is exceedingly abundant in Eagle Lake.

PLATES FOR PAPER ON
THE MOLLUSCA OF INDIANA.

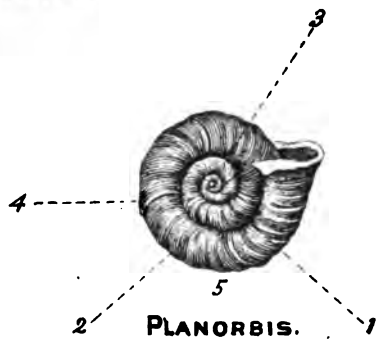
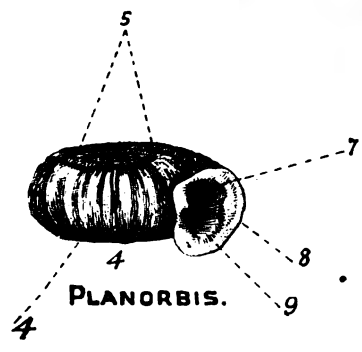
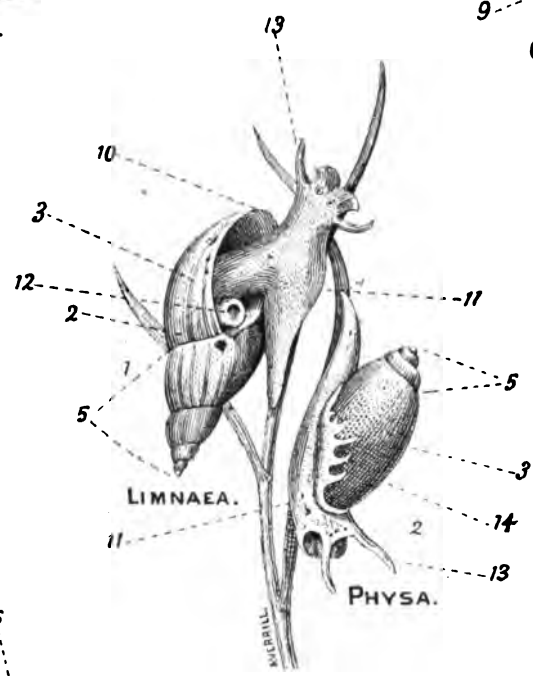
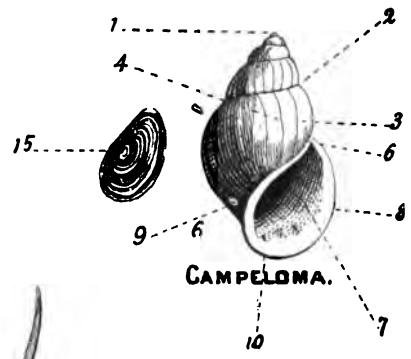
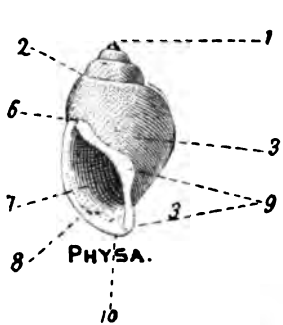


HYDROGRAPHIC MAP.

**EXPLANATION OF DESCRIPTIVE TERMS EMPLOYED
IN FRESH WATER UNIVALVES.**

PLATE 2.

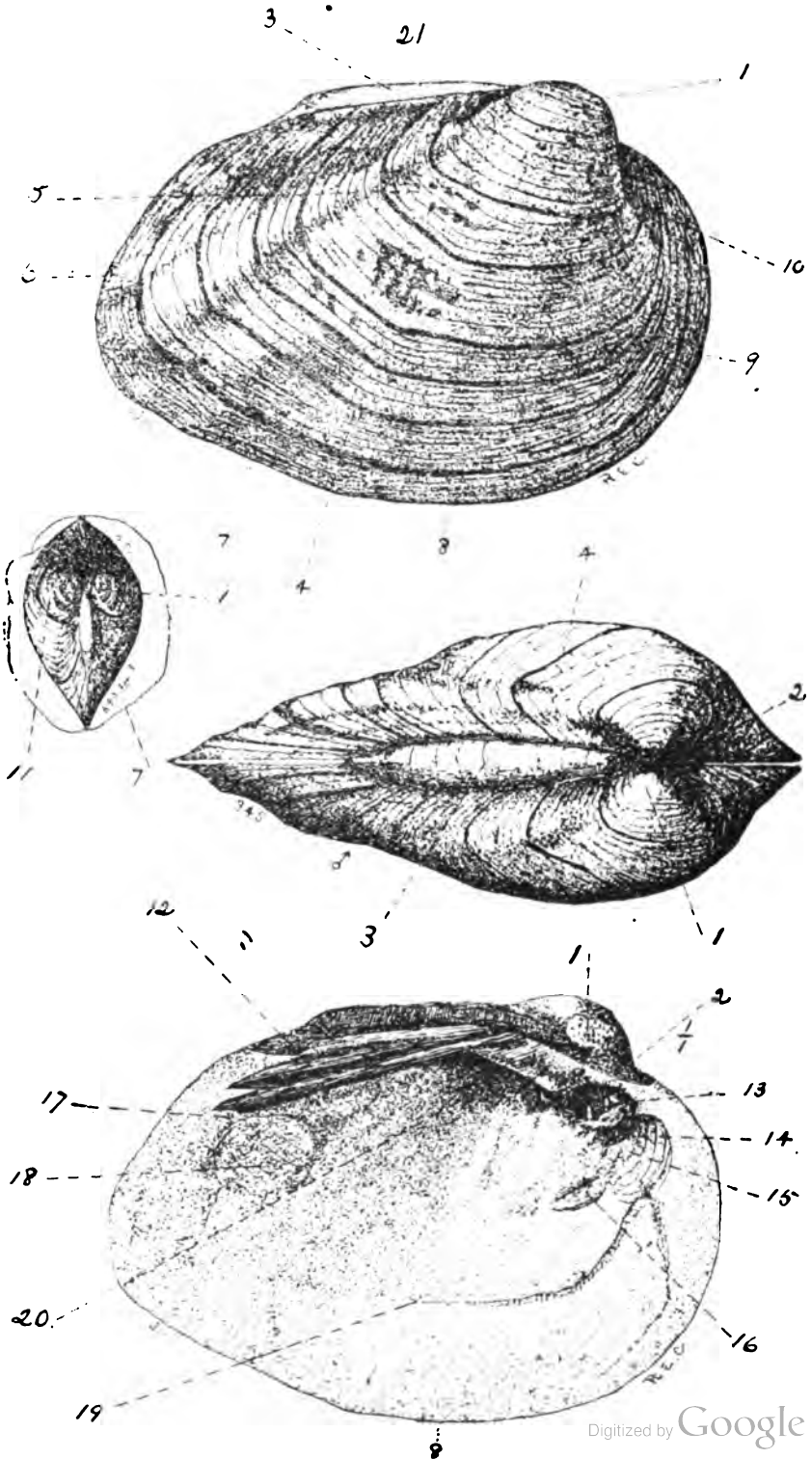
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|--------------------------------|--|
| 1. Apex. | 9. Columella. |
| 2. Suture. | 10. Inferior angle of margin or peristome. |
| 3. Body whorl. | 11. Disk, or foot. |
| 4. Lines of growth. | 12. Breathing pore. |
| 5. Spire. | 13. Tentacle. |
| 6. Superior angle of aperture. | 14. Mantle, fimbriated in Physa. |
| 7. Aperture. | 15. Operculum. |
| 8. Peristome. | |



**EXPLANATION OF DESCRIPTIVE TERMS EMPLOYED
IN UNIO.**

PLATE 3.

- | | |
|-----------------------------|---|
| 1. Umbone. | 12. Lateral hinge teeth. |
| 2. Lunule. | 13. Anterior or cardinal hinge teeth. |
| 3. Ligament. | 14. Anterior retractor pedis impression. |
| 4. Line of growth. | 15. Anterior adductor cicatrix or scar. |
| 5. Posterior umbonal slope. | 16. Protractor pedis muscular impression. |
| 6. Posterior margin. | 17. Posterior retractor pedis impression. |
| 7. Sulcus, or emargination. | 18. Posterior adductor impression. |
| 8. Ventral margin. | 19. Pallial line. |
| 9. Anterior margin. | 20. Cavity of the beaks, or umbones. |
| 10. Anterior umbonal slope. | 21. Dorsal margin. |
| 11. Embryonic shell. | |



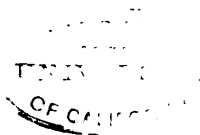


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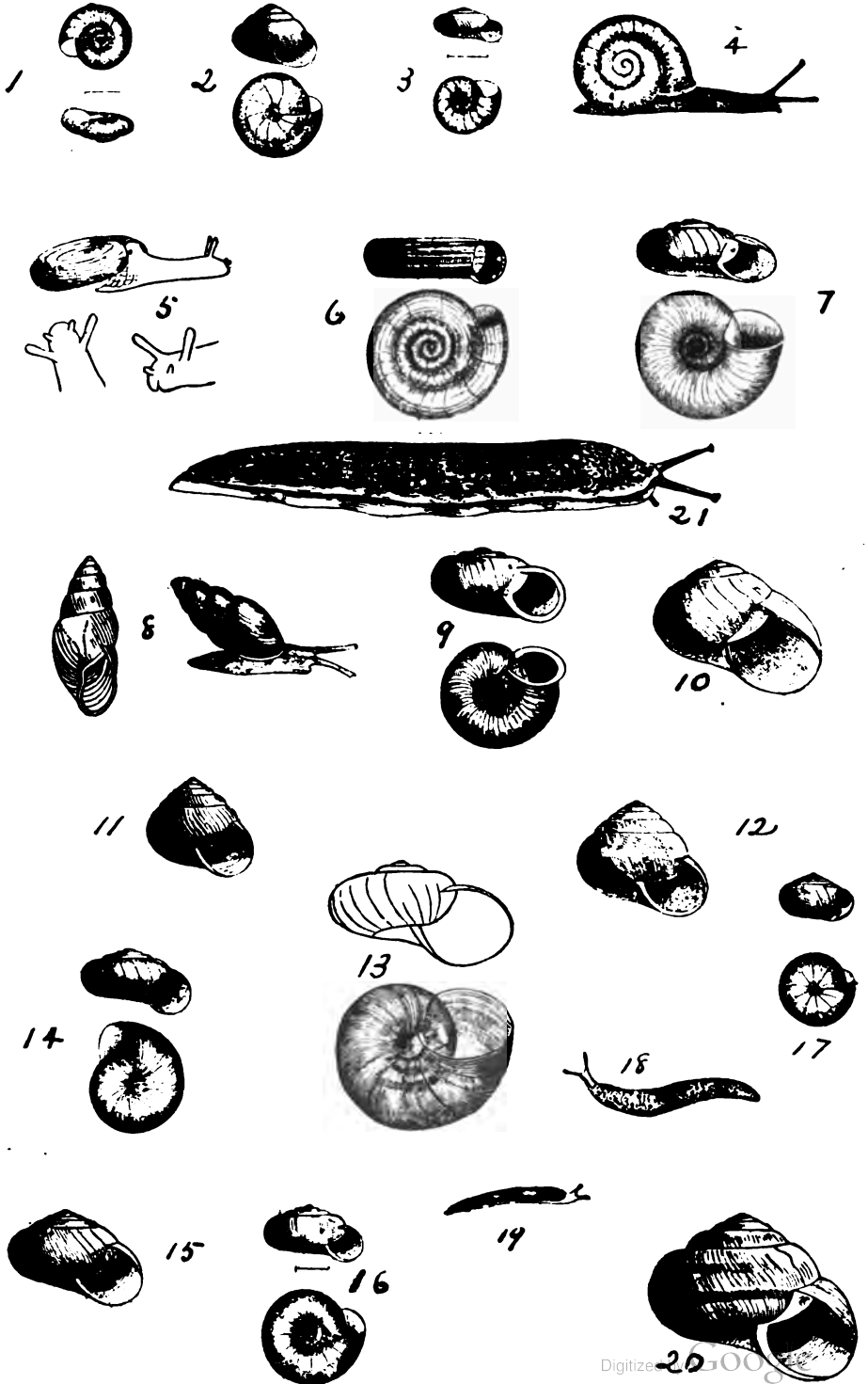
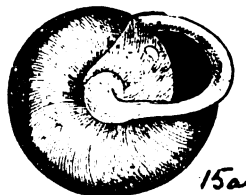
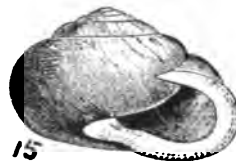
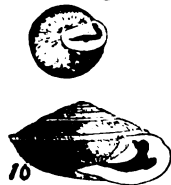
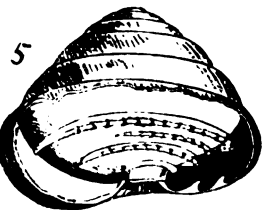
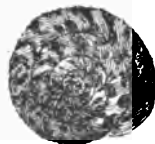




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LAND MOLLUSCA.

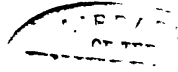
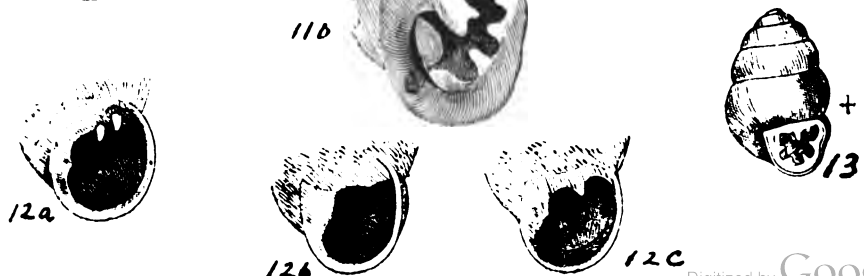
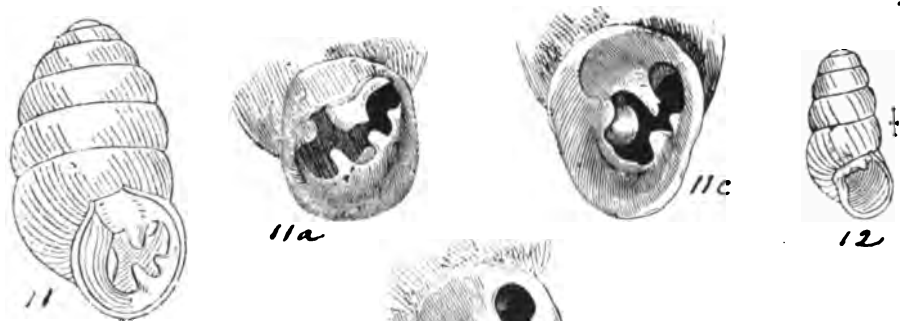
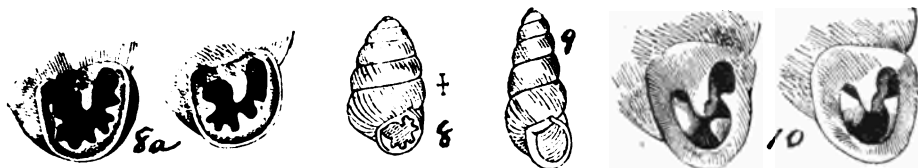
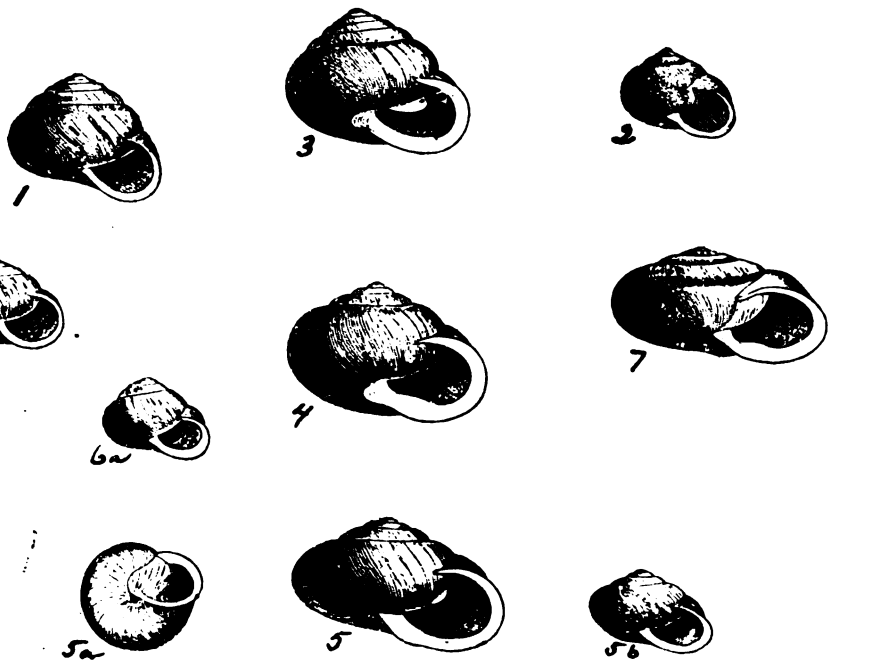


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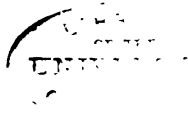


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The remaining figures of this plate are self-explanatory. They all deal with the details of jaw structure, which are believed to be useful for purposes of classification. Only generic forms are here shown.

4



2



3



Jaw of *Z. arboreus* (Morse)



Jaw of *Pupa pentodon*.
(Morse)



Jaw of *lineatus*.



Jaw of *E. subgibbatica*.



Jaw of *T. appressa*.



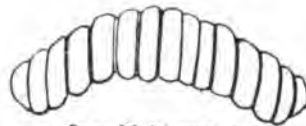
Jaw of *Vertigo oca*. (Morse.)



Jaw of *L. flavus*.



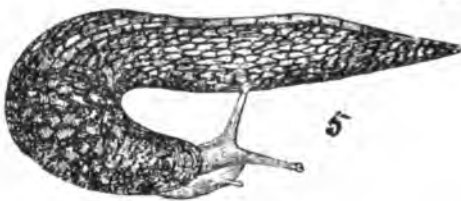
Jaw of *T. dorsalis*.



Jaw of *S. labyrinthica*.



Jaw of *S. Totteniana*. (Morse.)



5



Jaw of *S. monodon*.
(Morse.)



Jaw of *S. monodon*. (Morse.)

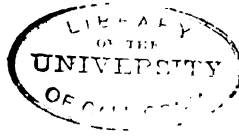
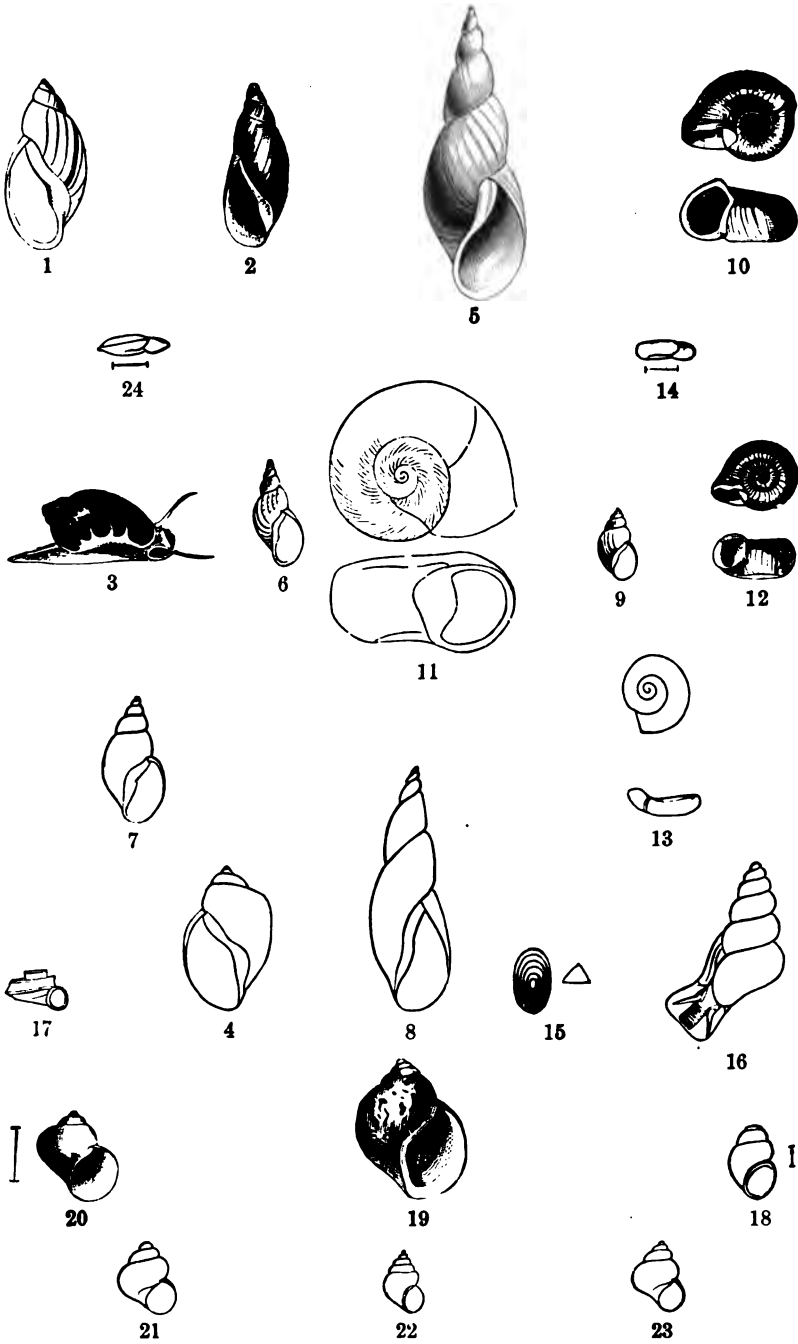


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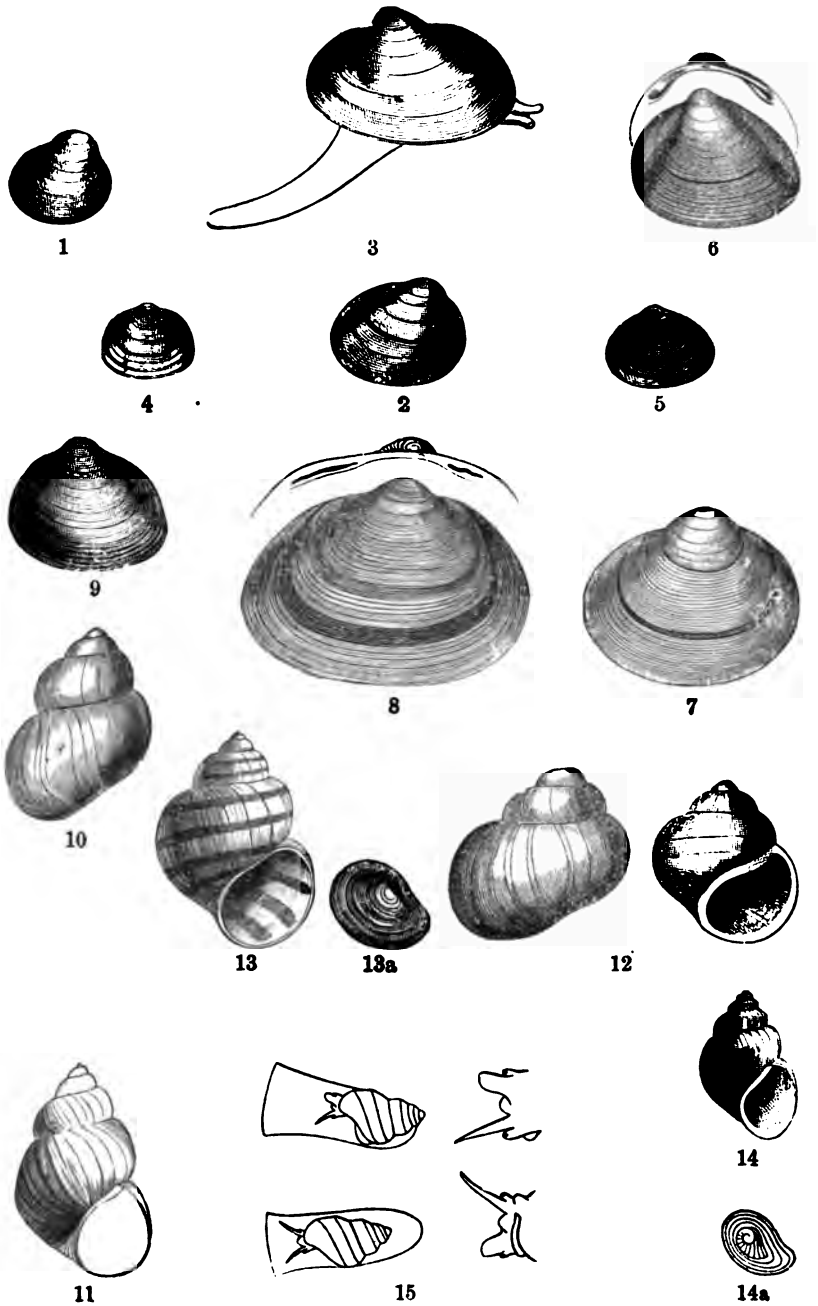


LIMNÆIDÆ, VALVATIDÆ AND RISSOIDÆ.

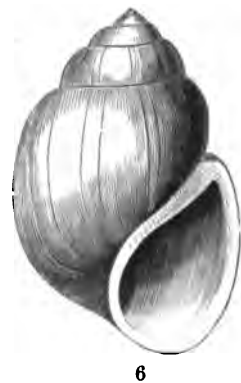
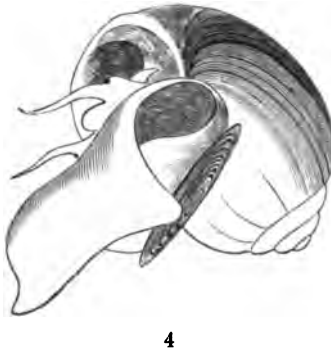
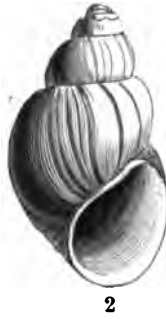


PLATE 9.

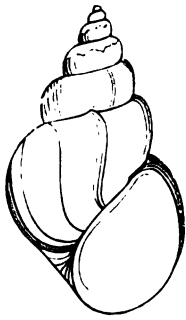
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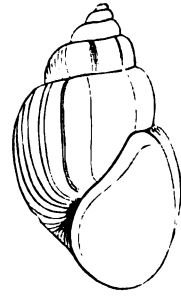
C. decisum, 1-3. *C. ponderosum*, 4-6.



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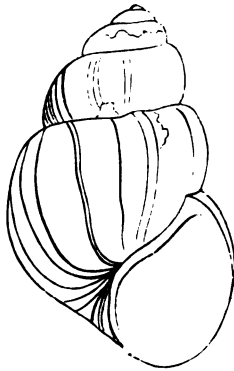
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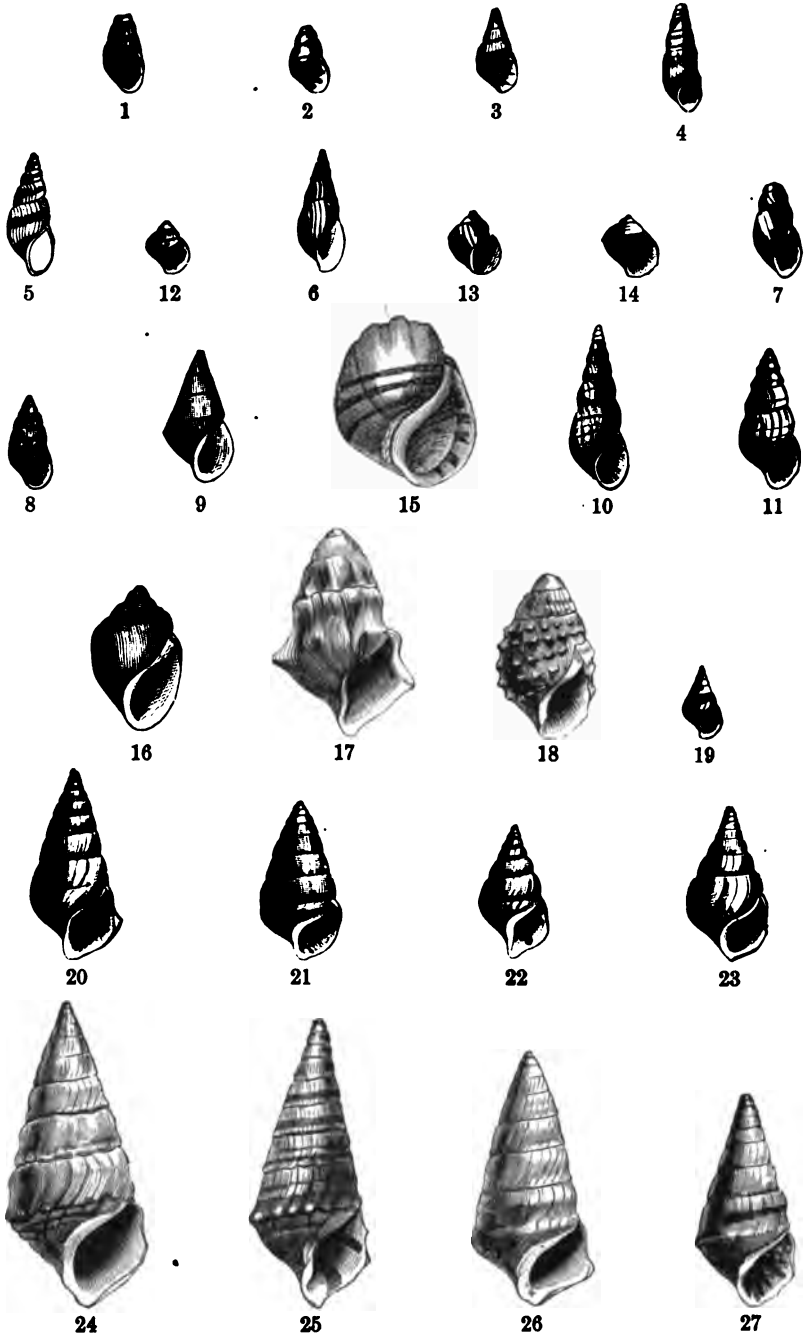


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C. subsolidum, 1-7. *C. rufum*, 8-9. *C. integrum*, 10-12.

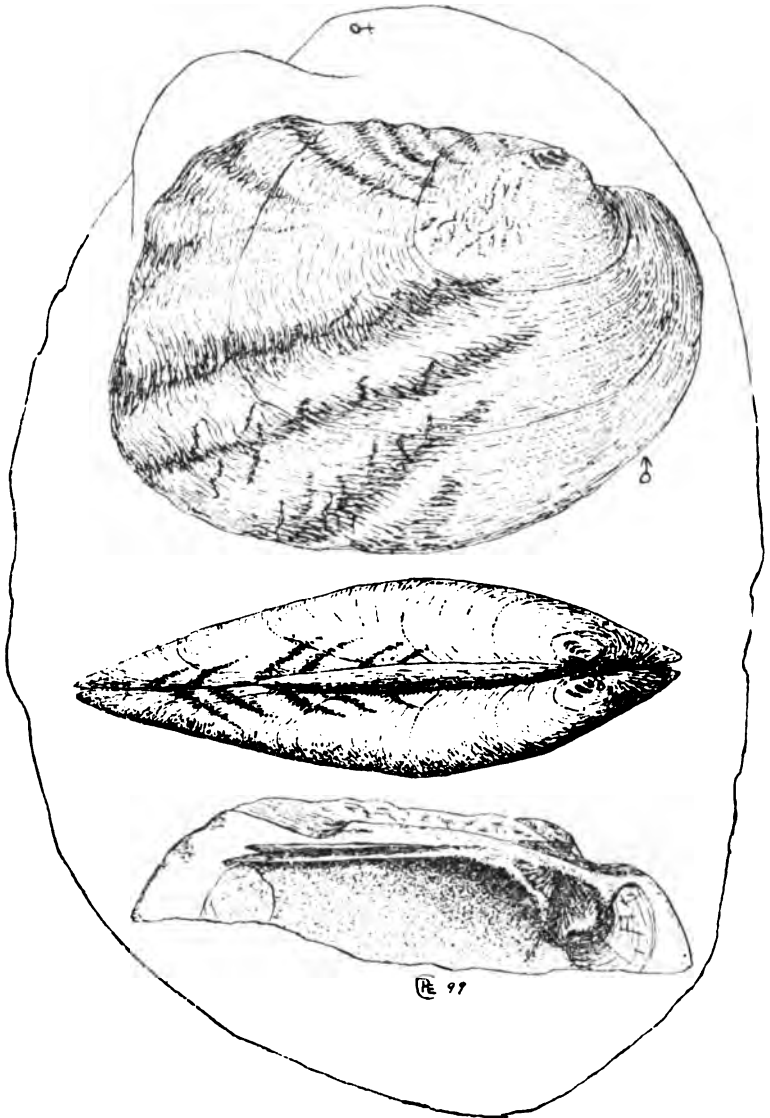
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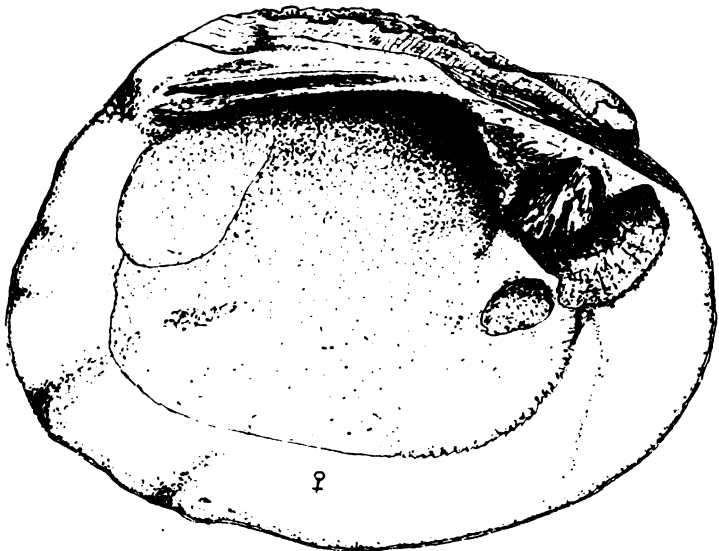
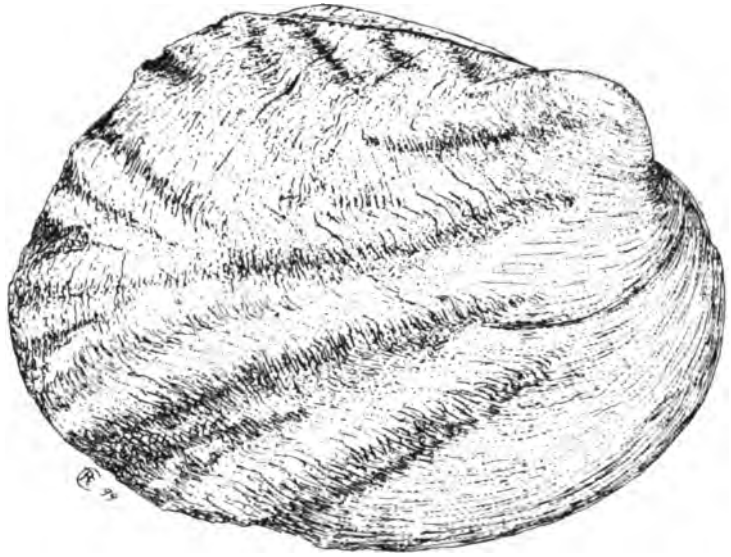


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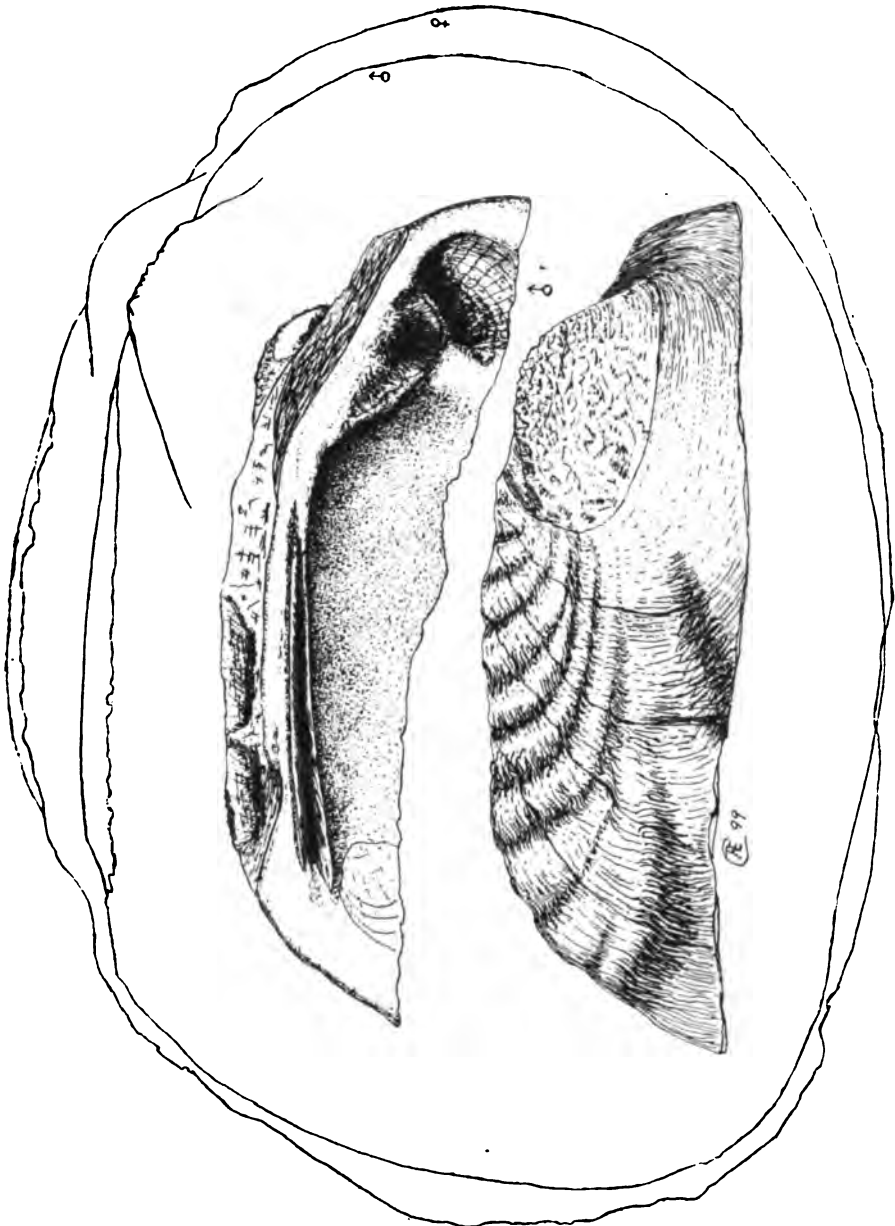




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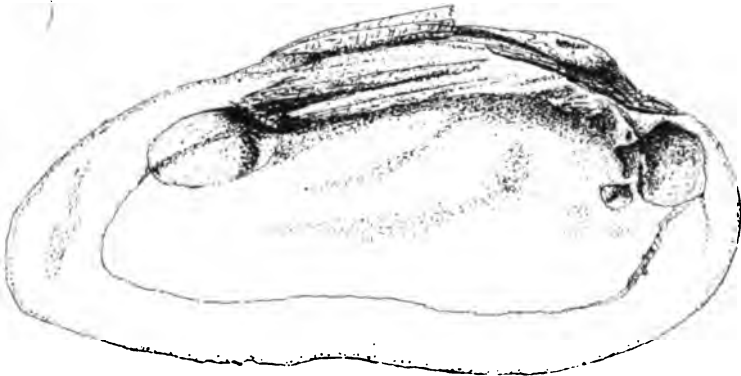
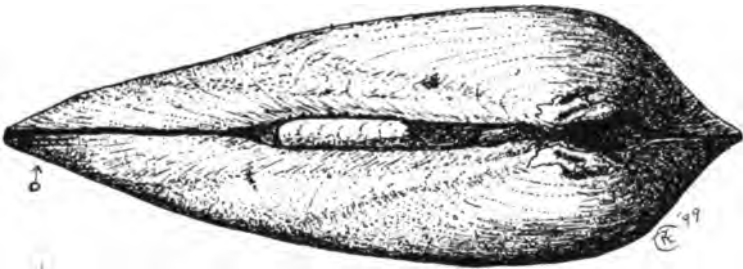
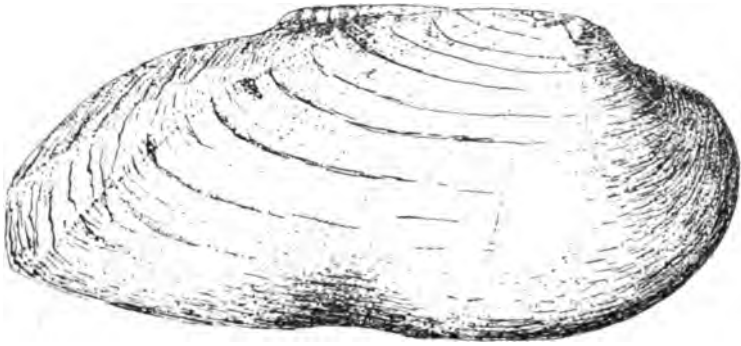


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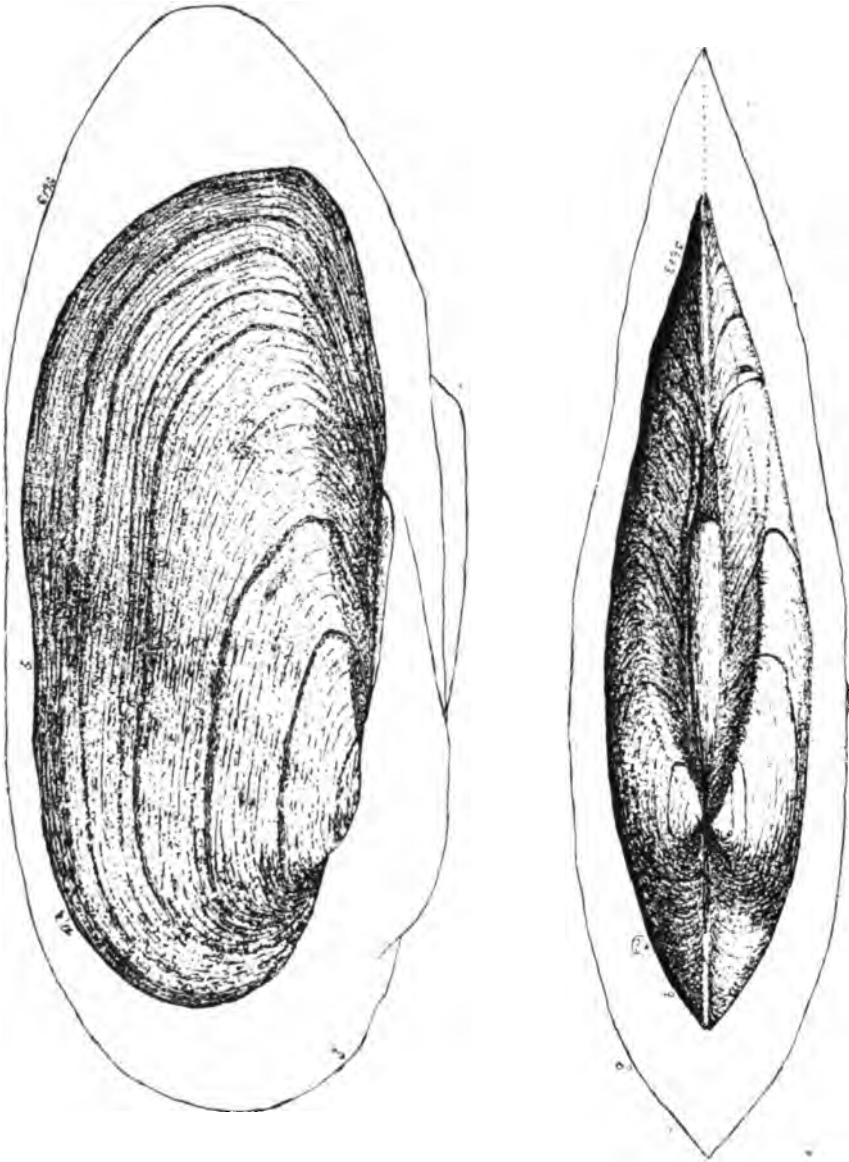
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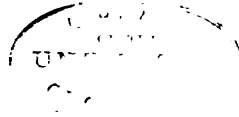


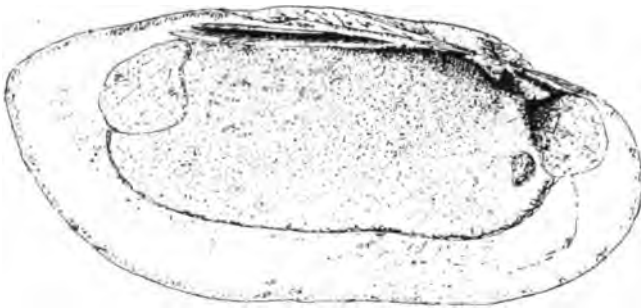
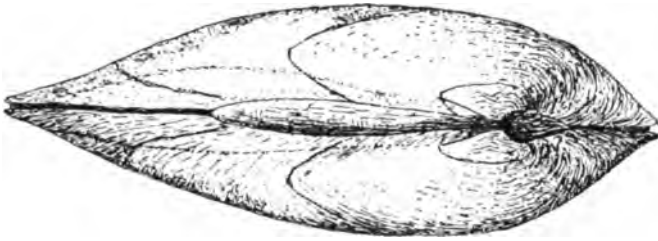
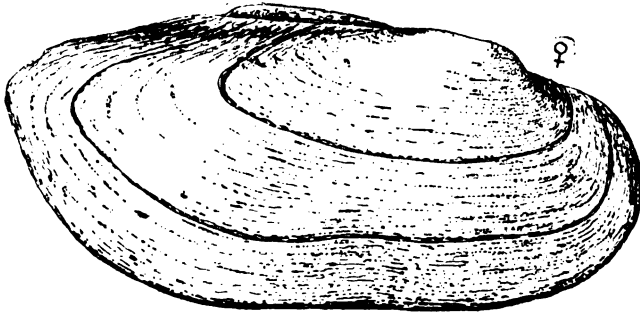
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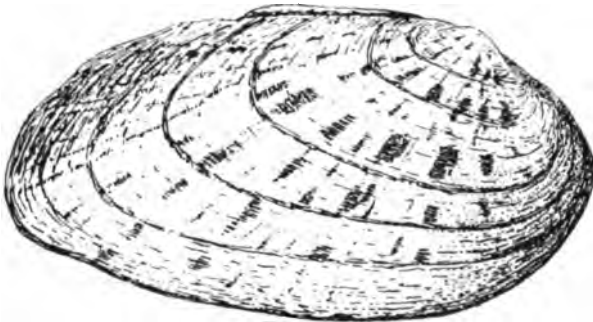
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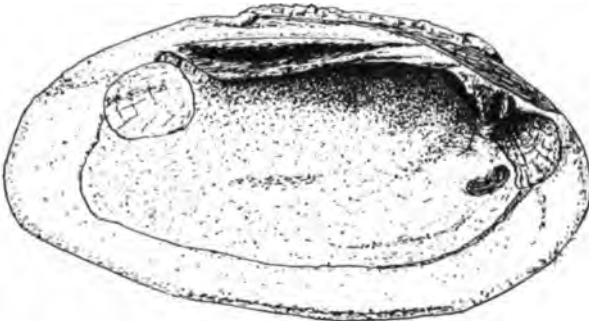
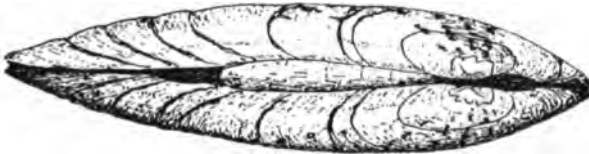


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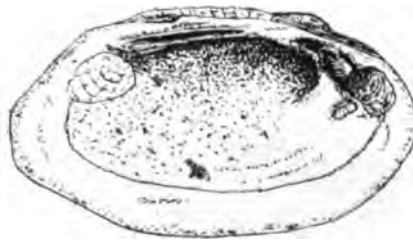
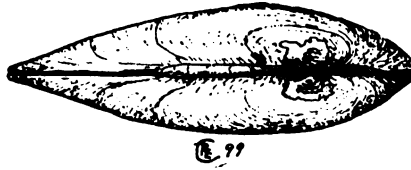




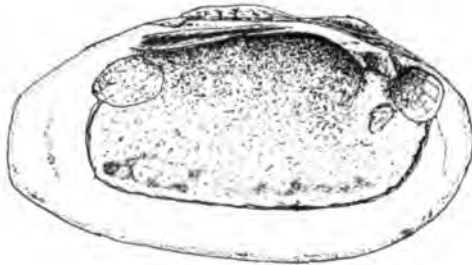
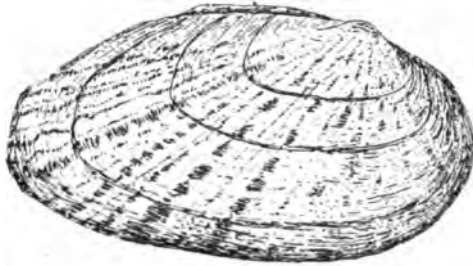
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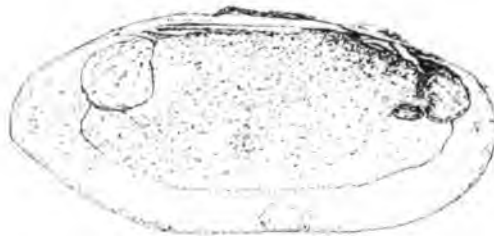
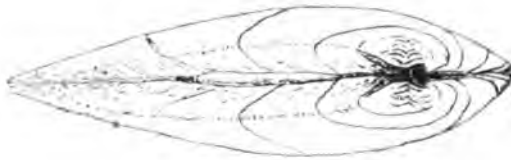
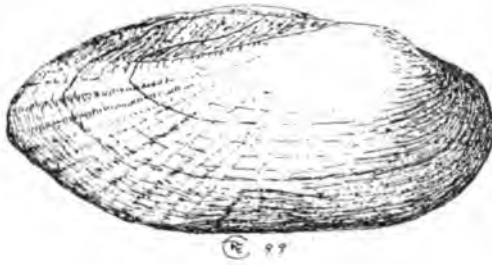
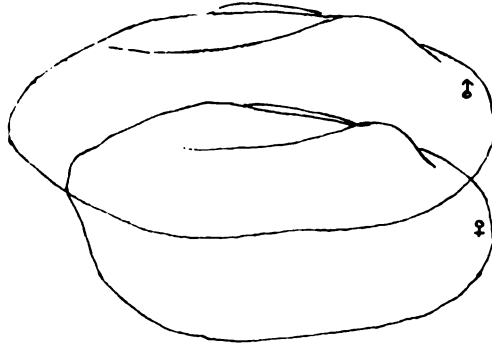
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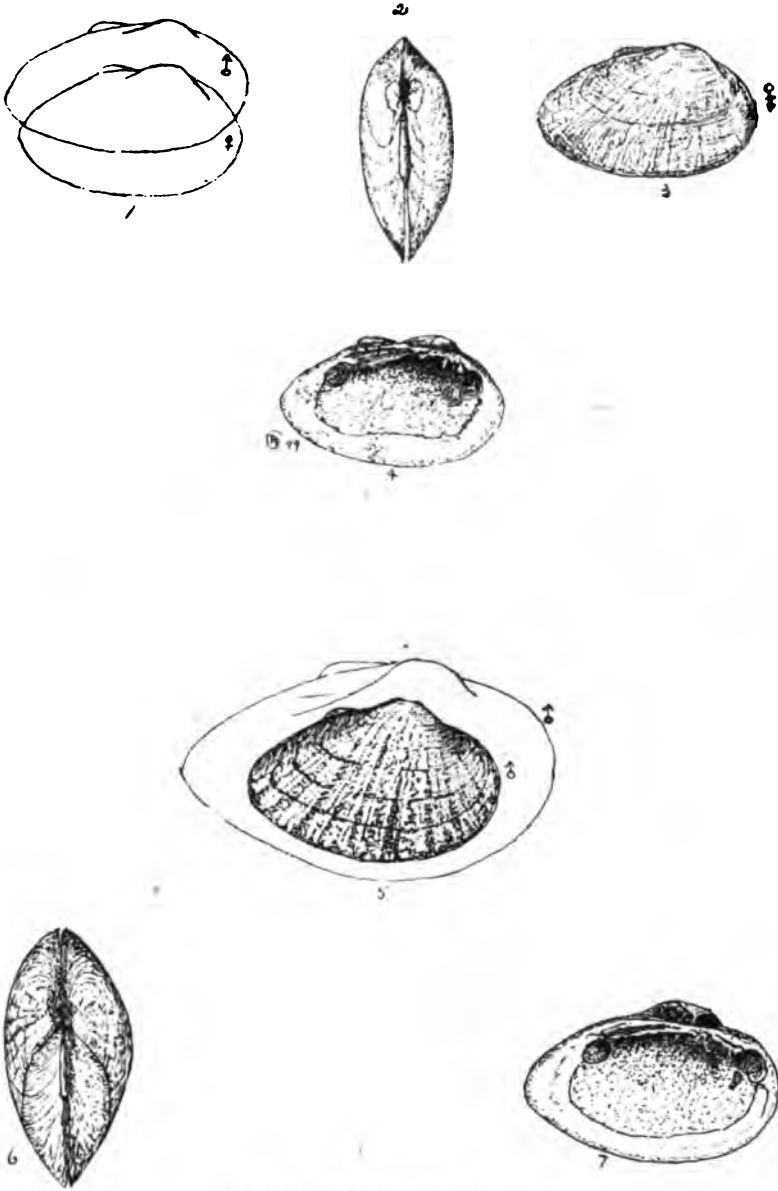


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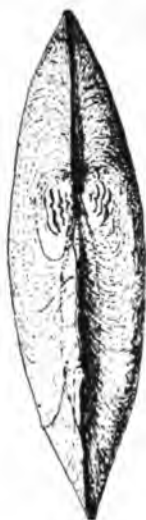
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5-7, UNIO DONACIFORMIS Lea.

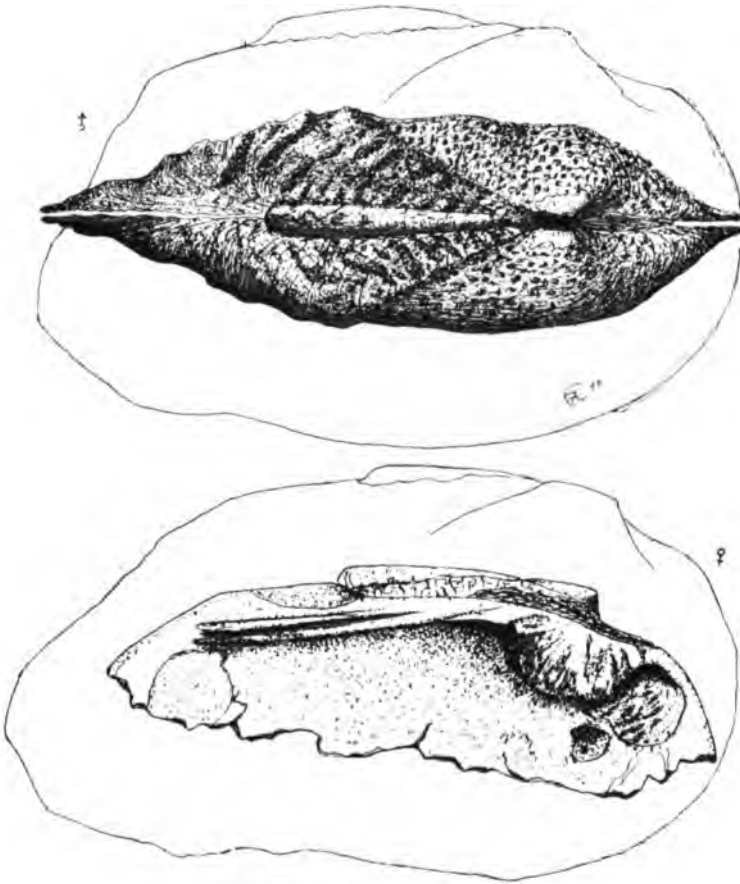
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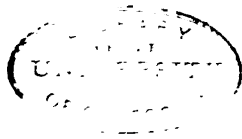
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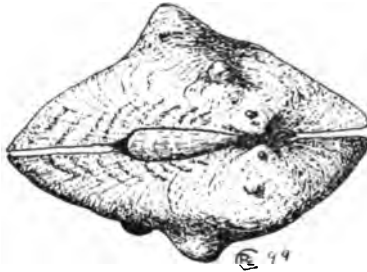


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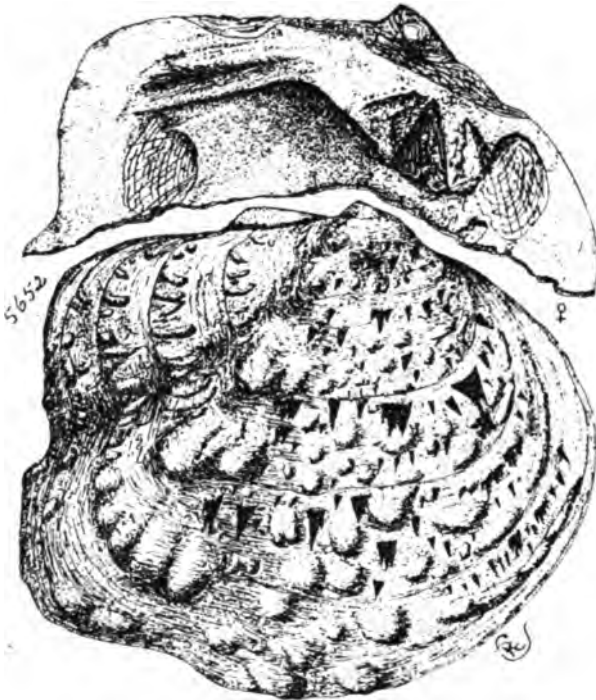
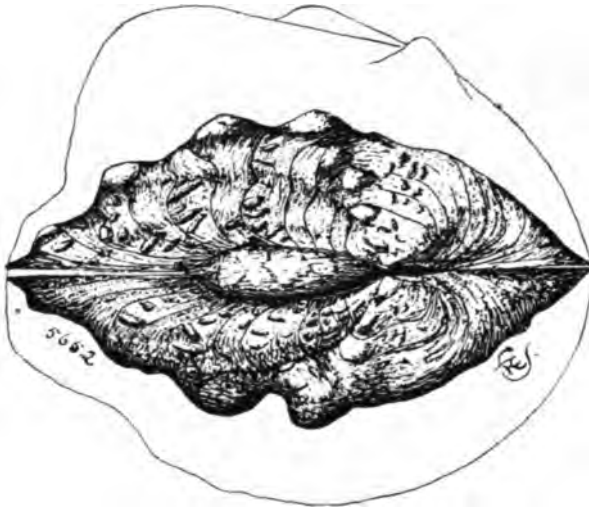


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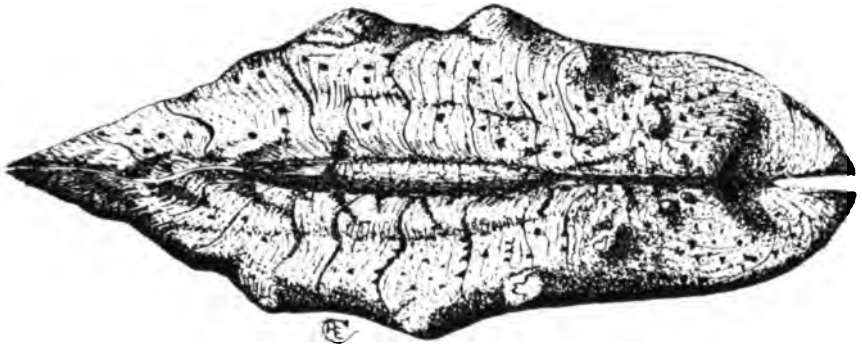
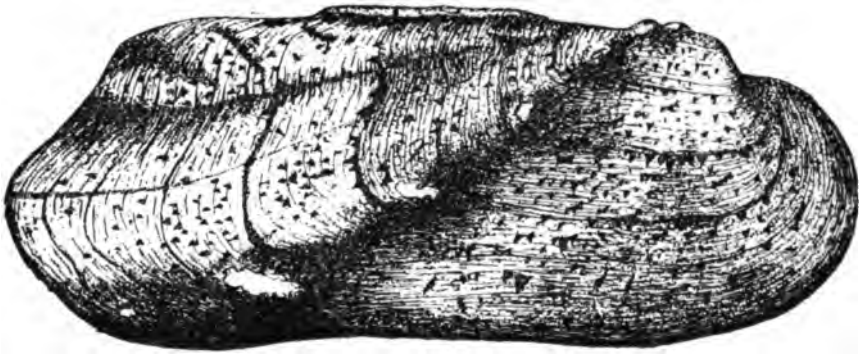
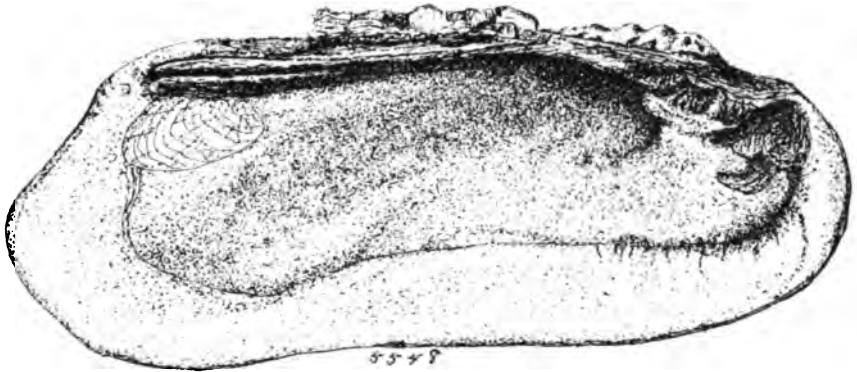




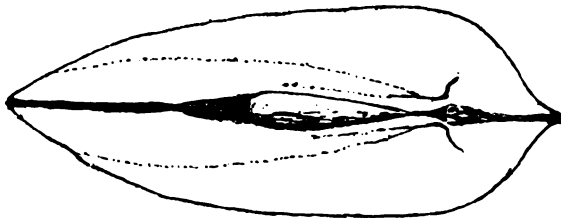
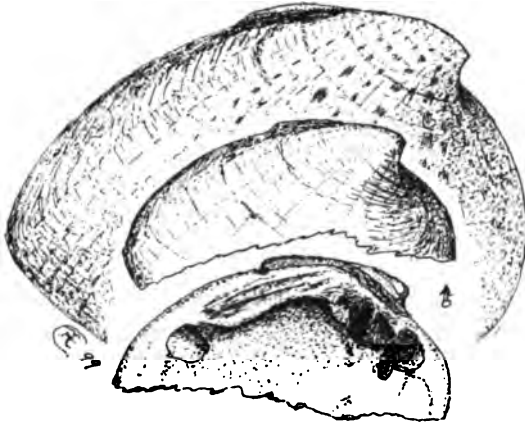
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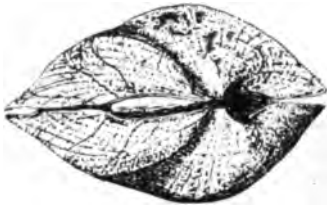


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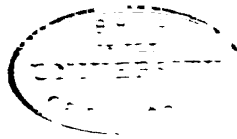


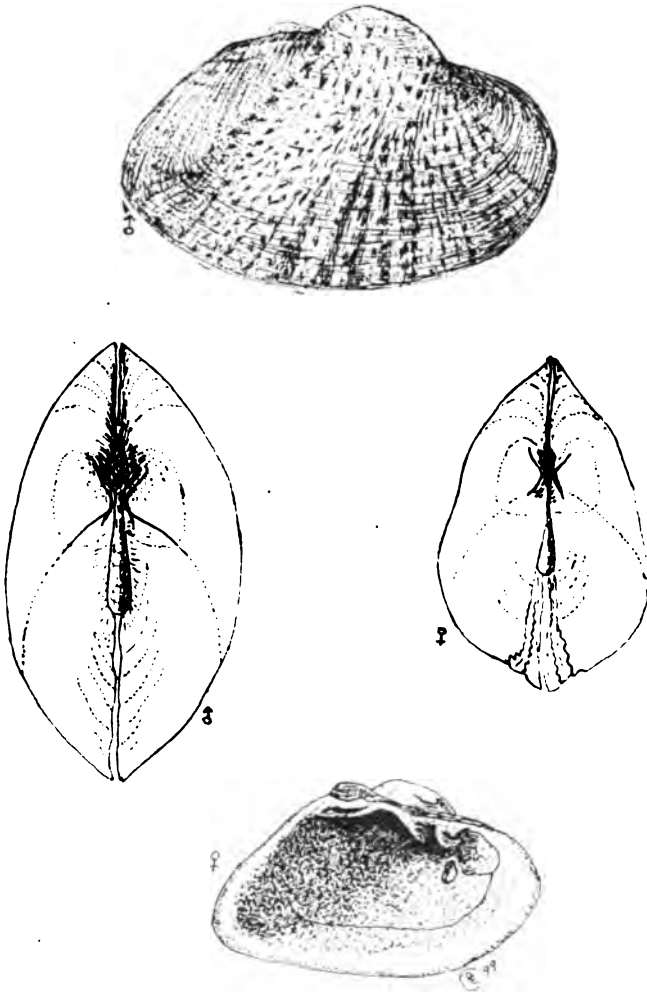
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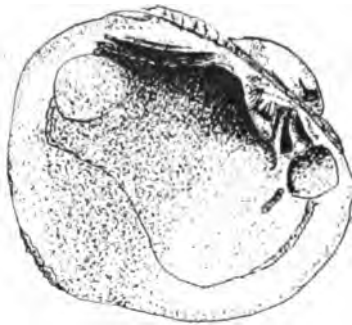
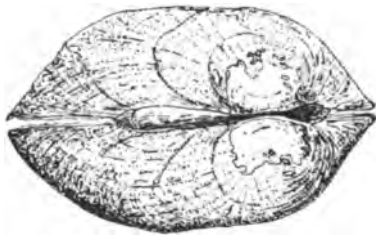
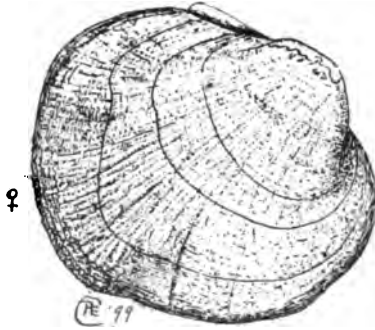


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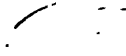


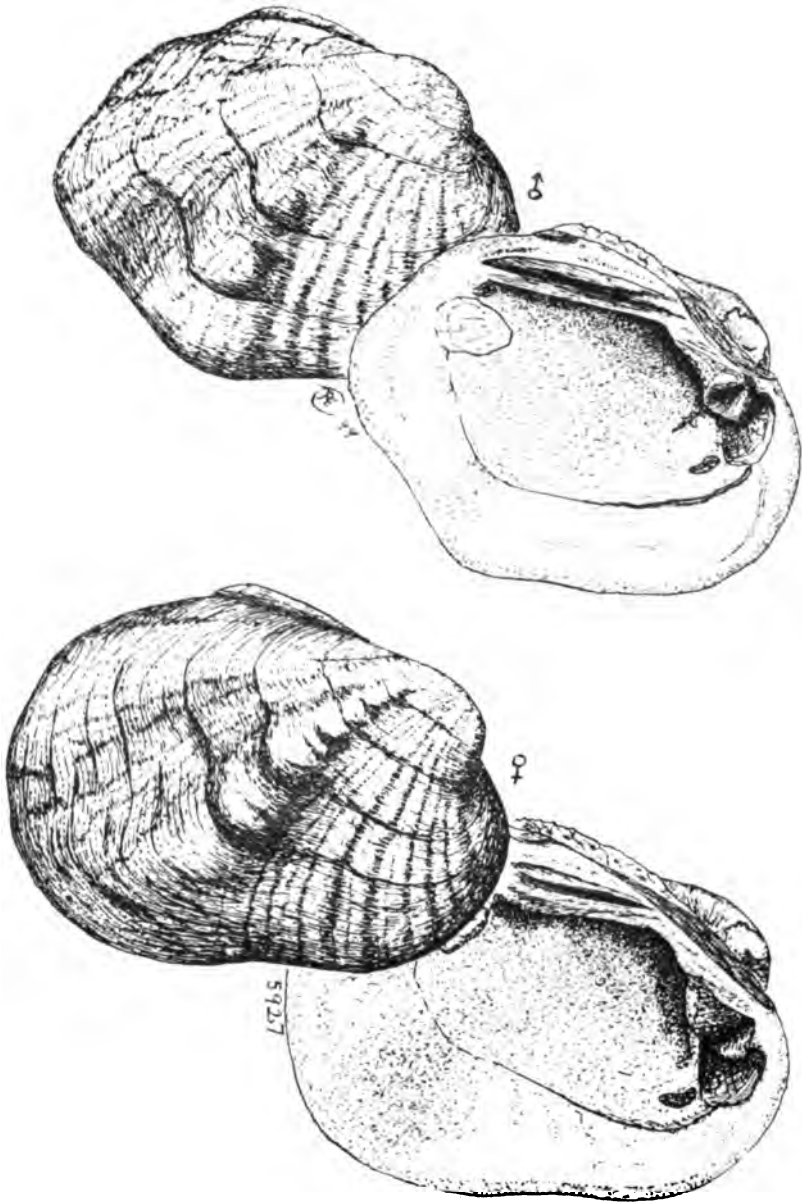


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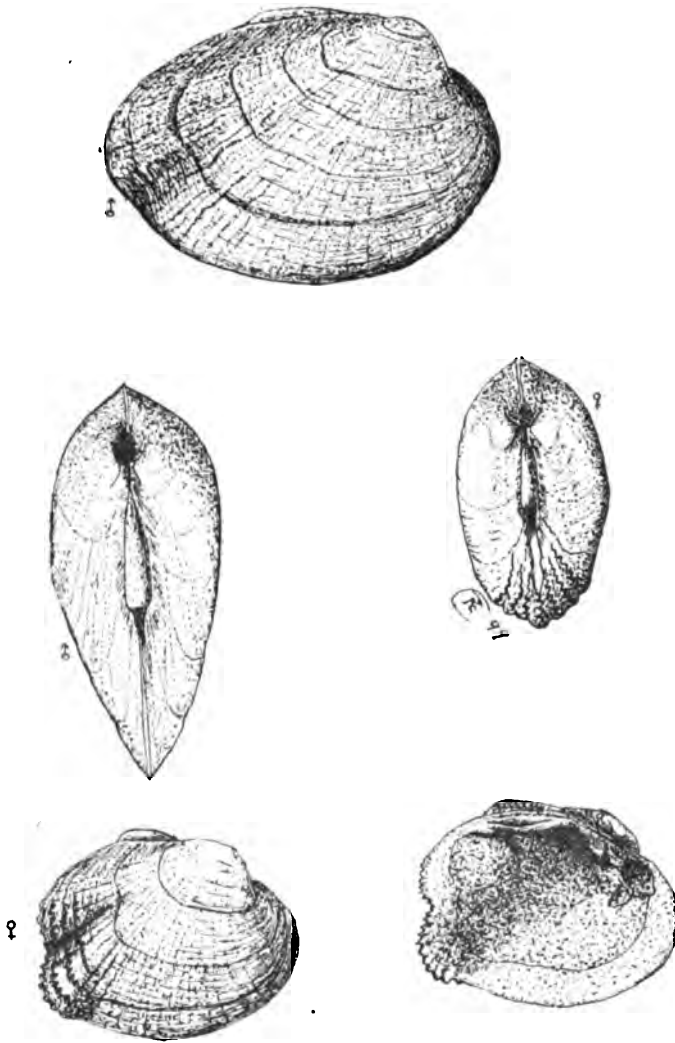
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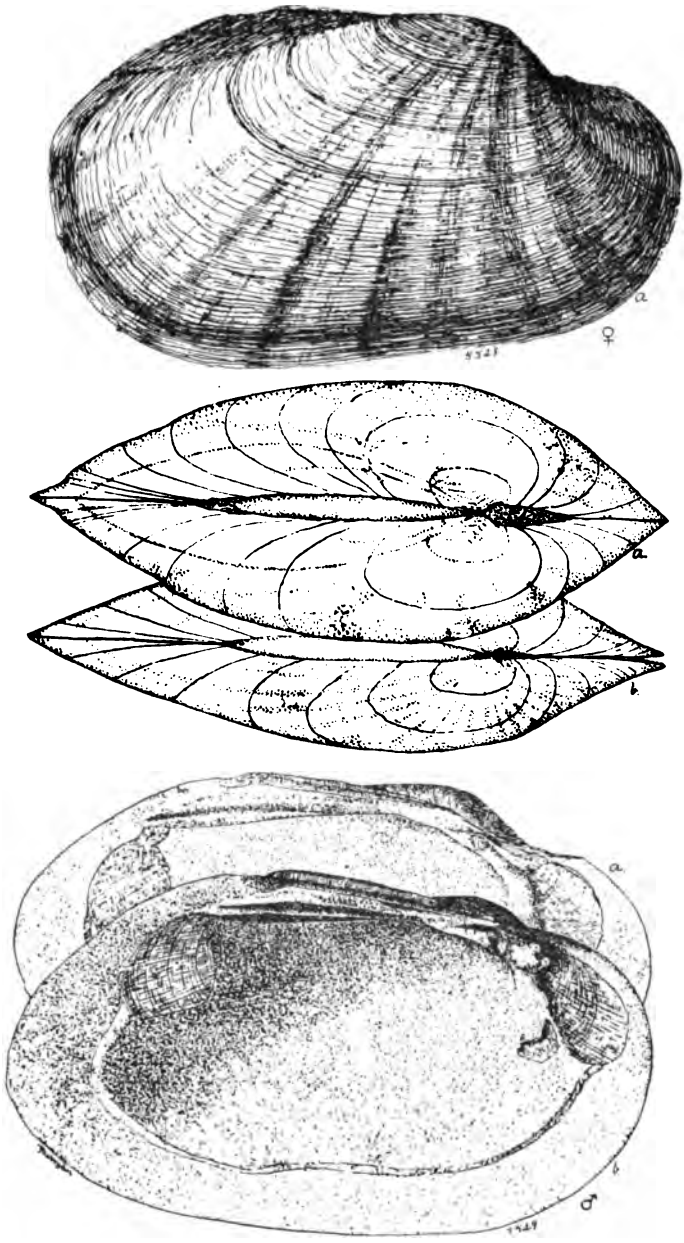
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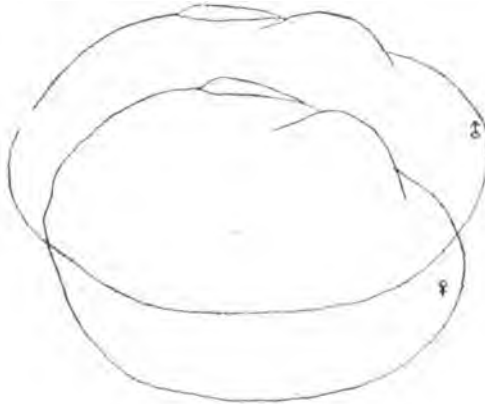


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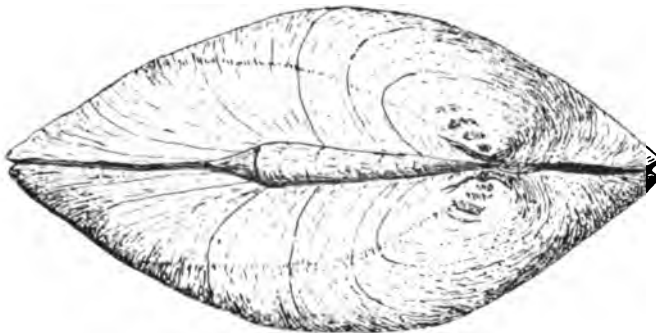
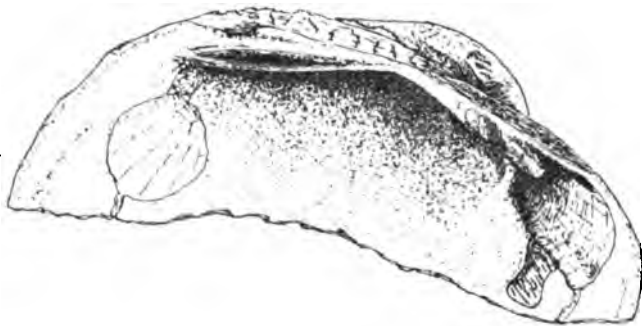
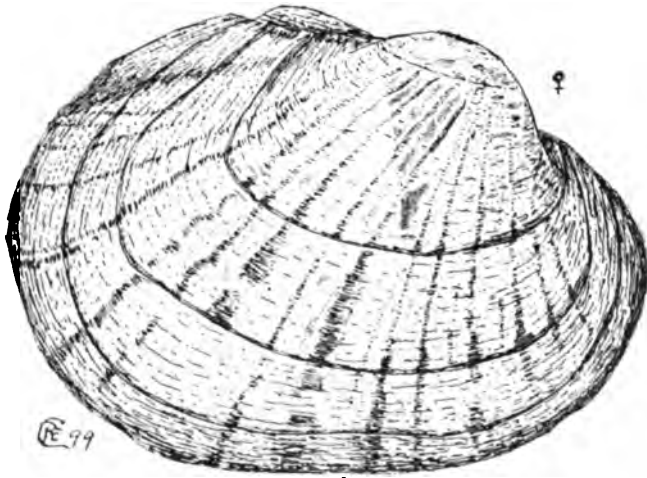




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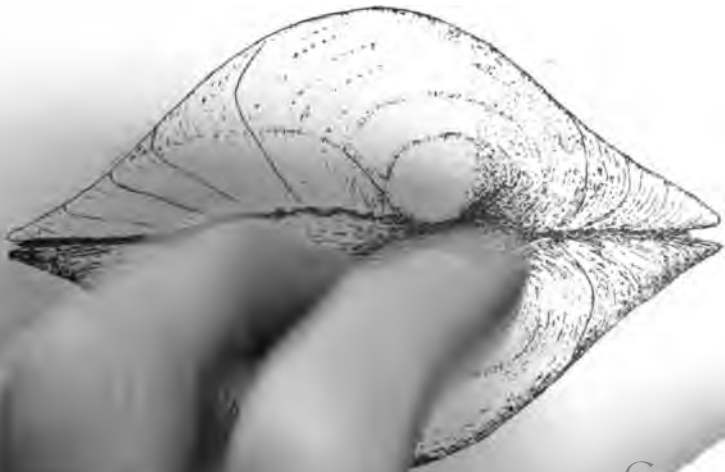
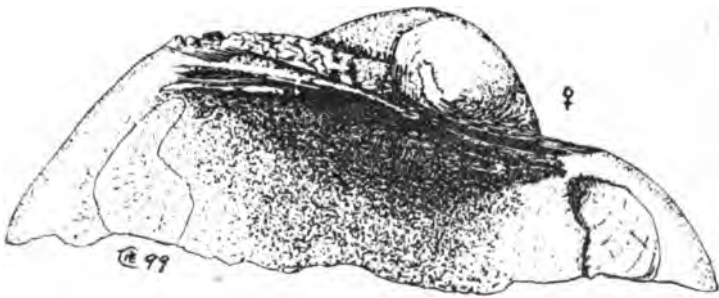
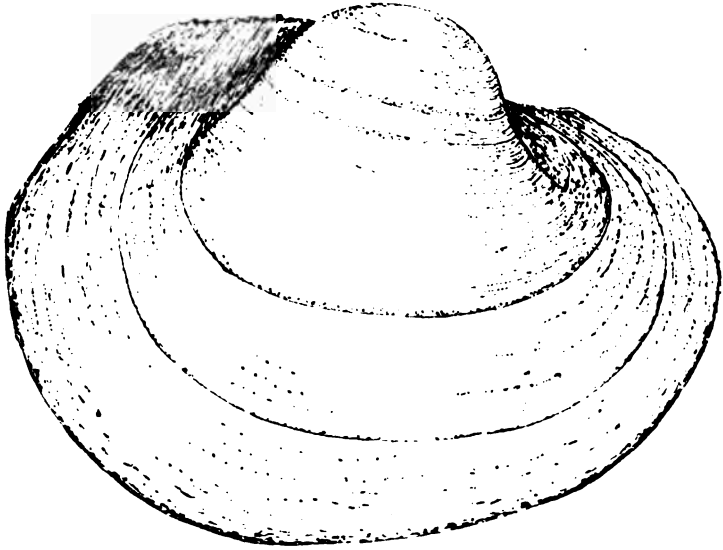
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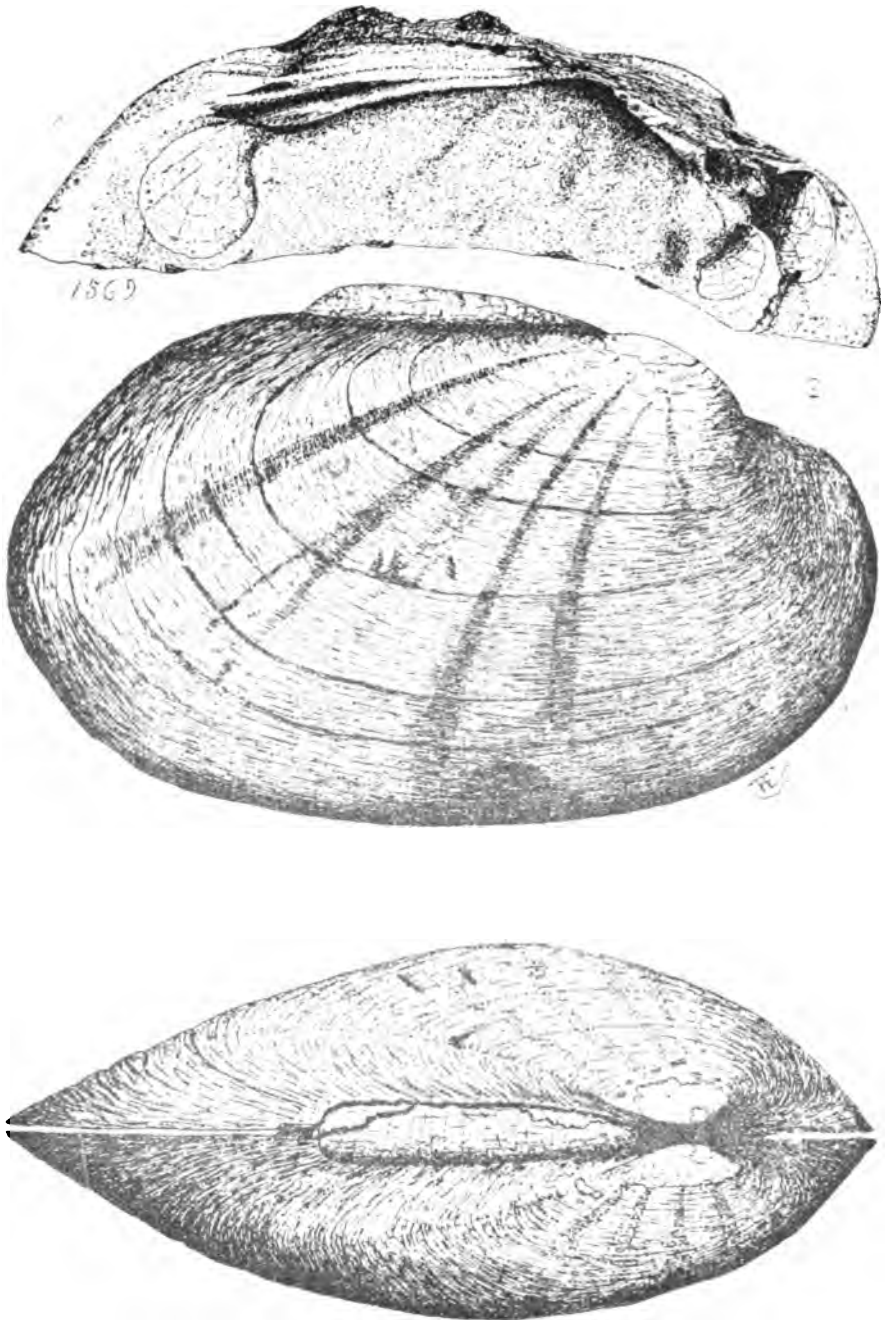


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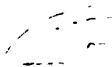


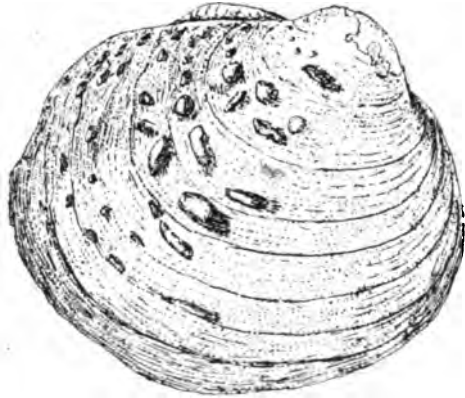


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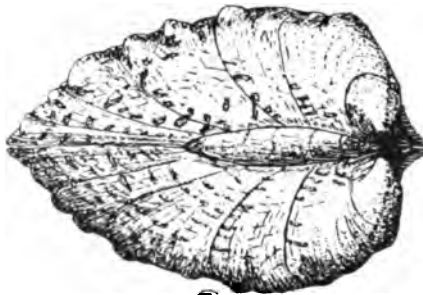


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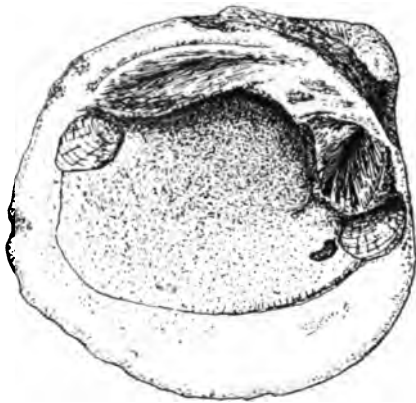




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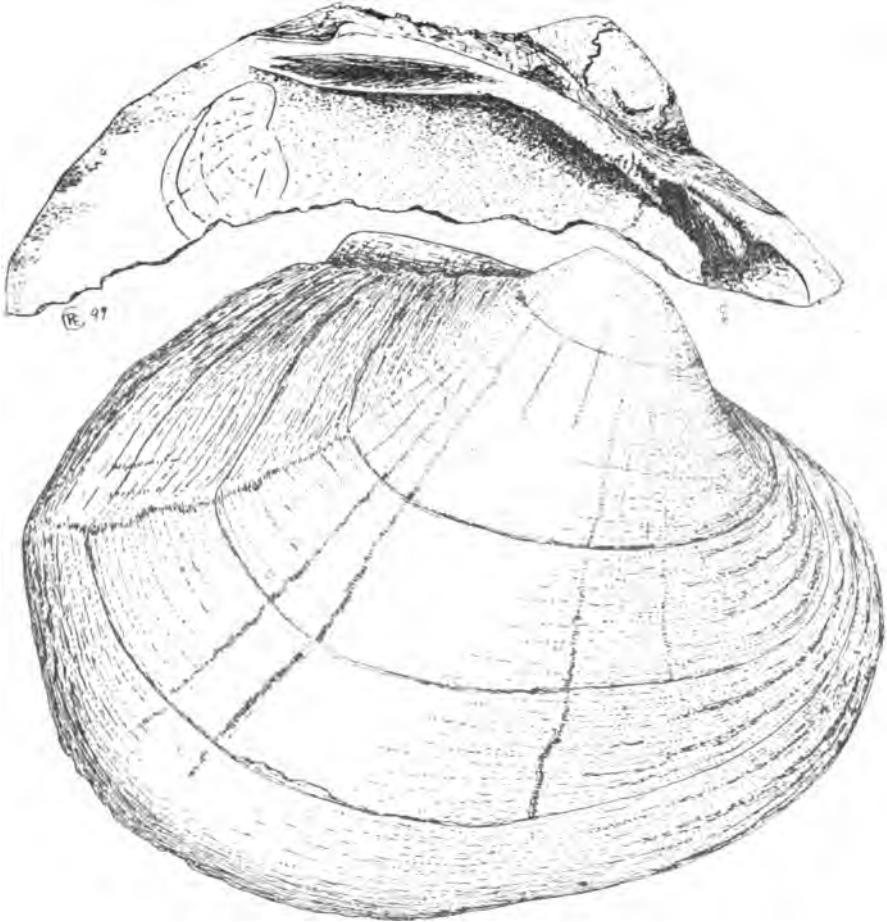


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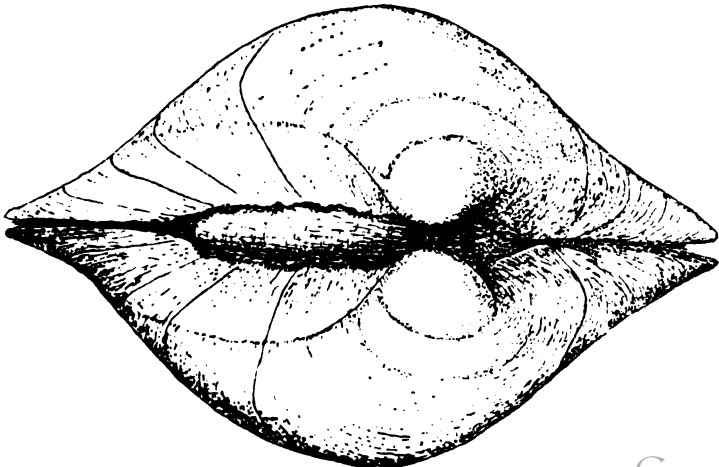
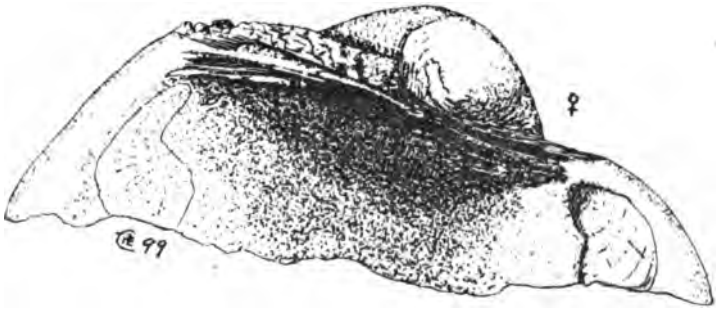
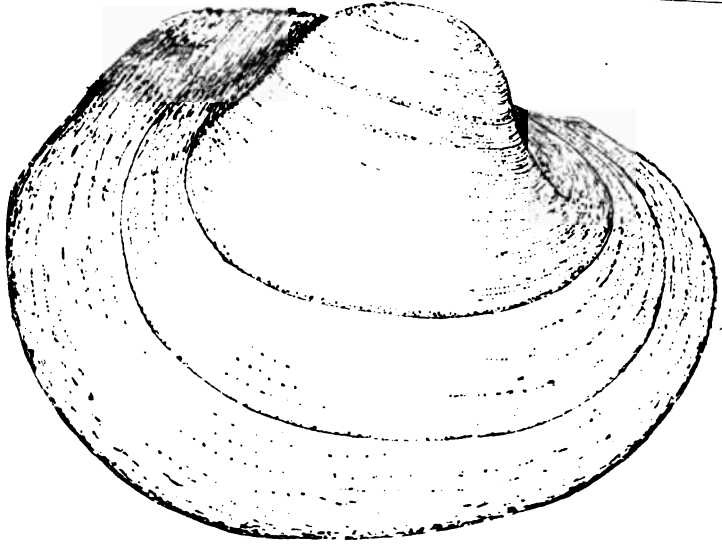
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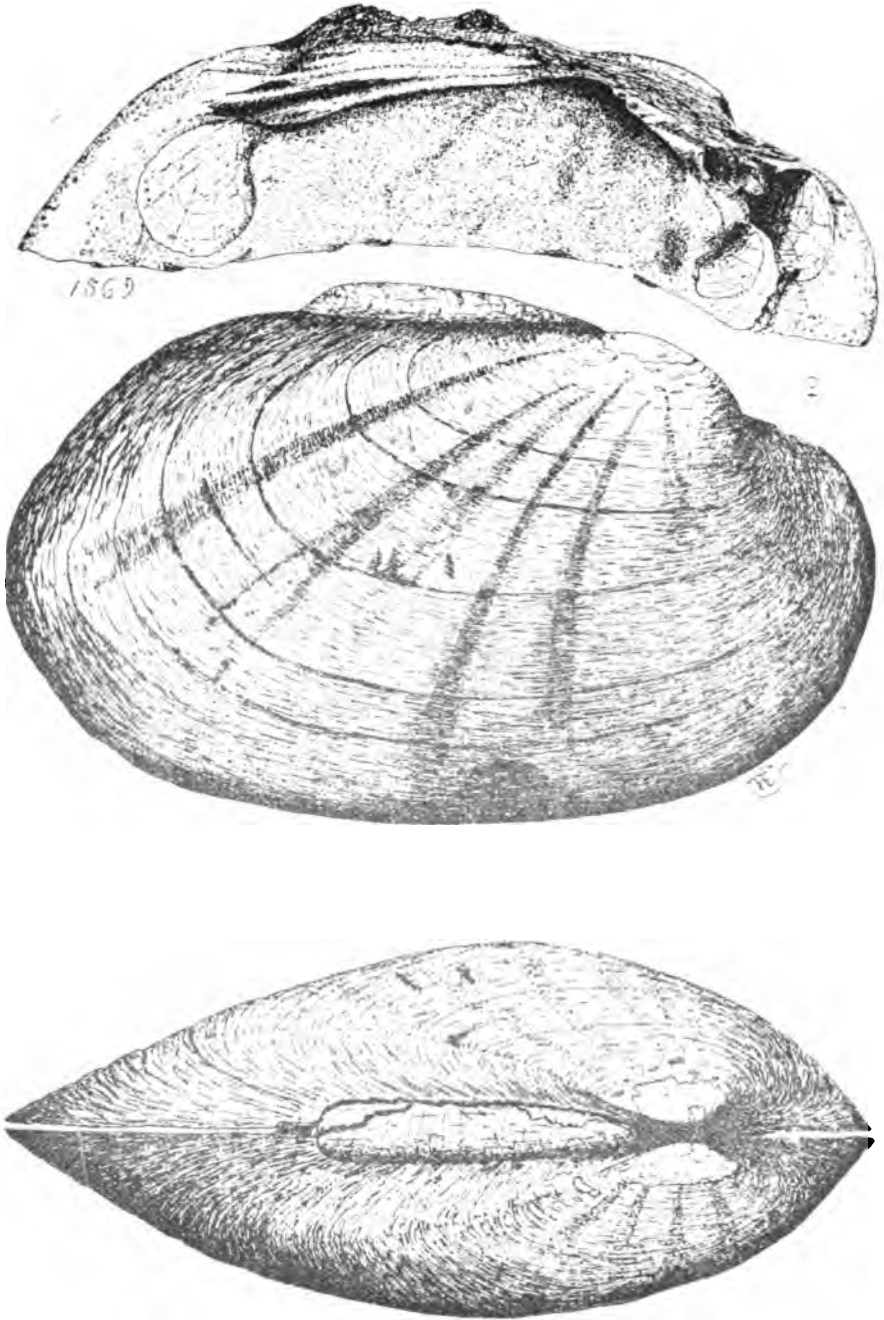
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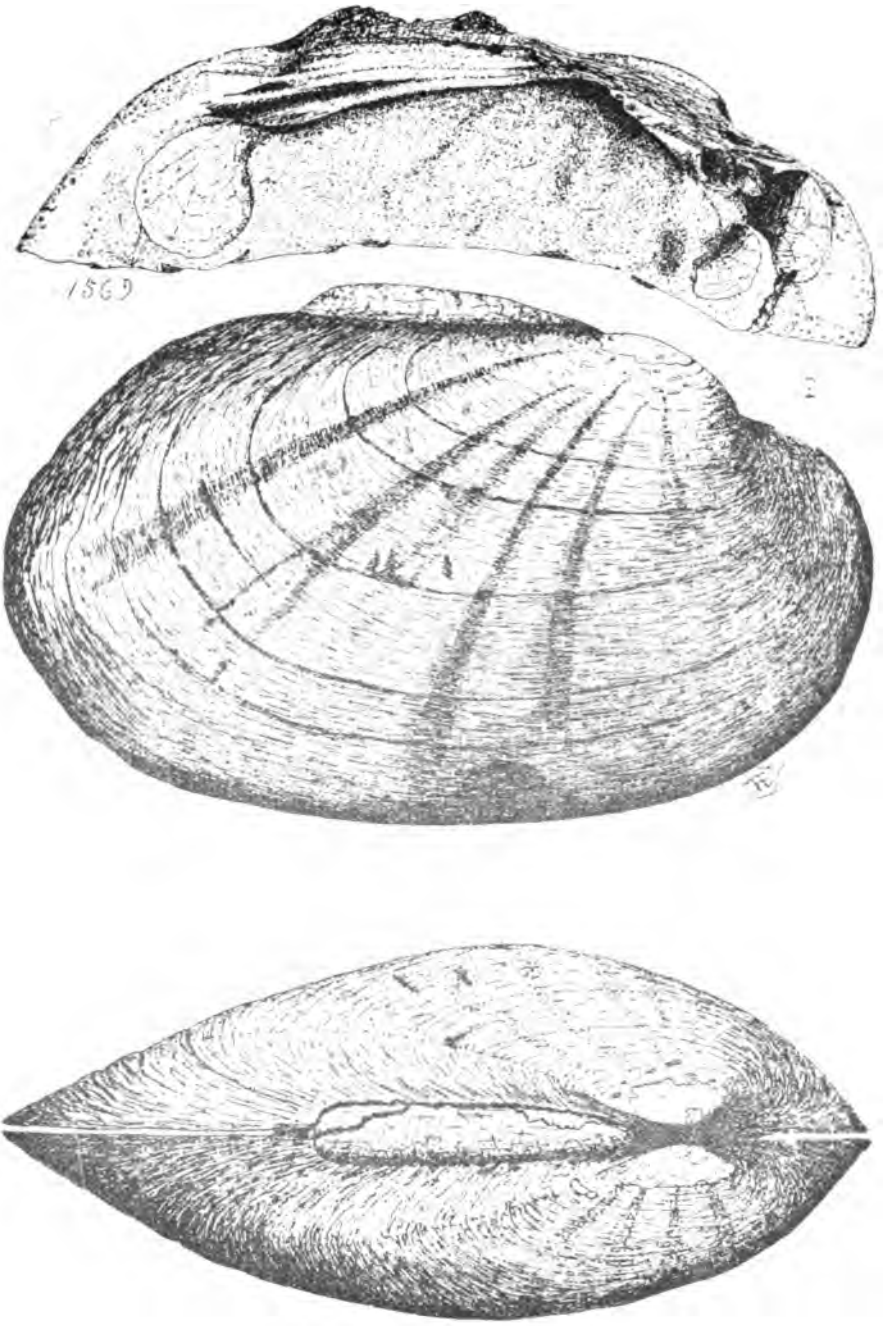




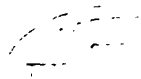


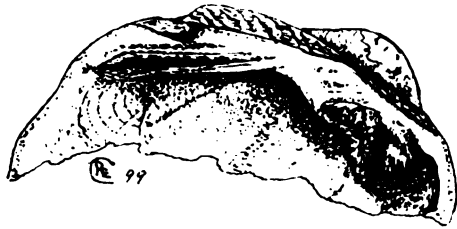
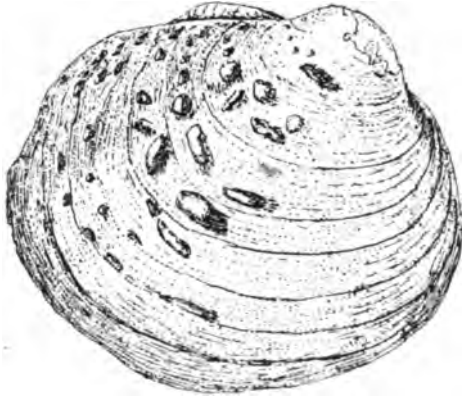
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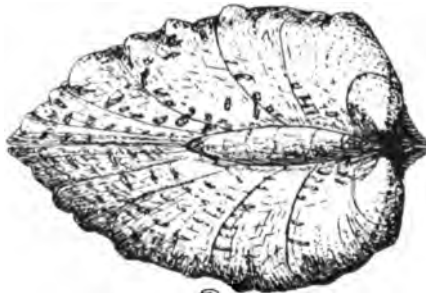


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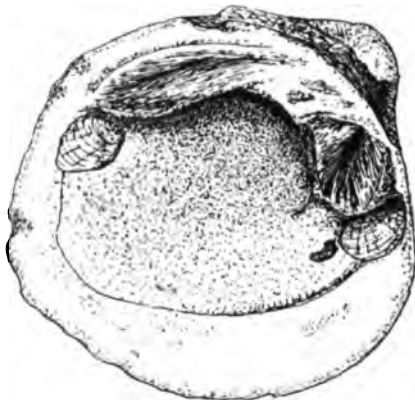




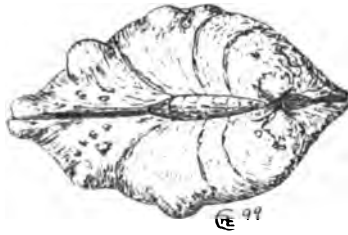
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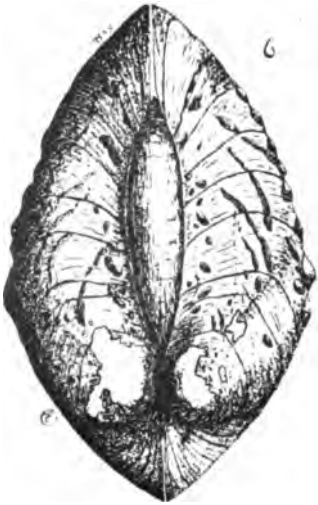
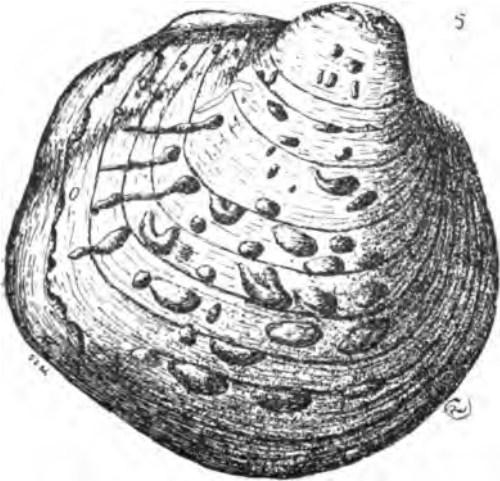
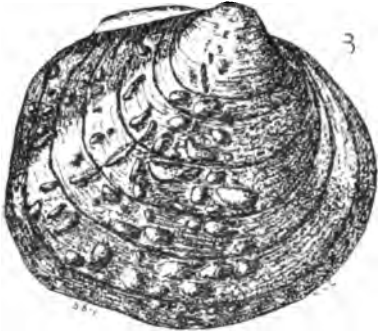
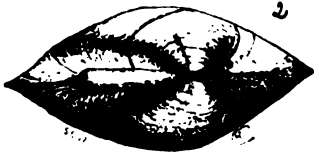
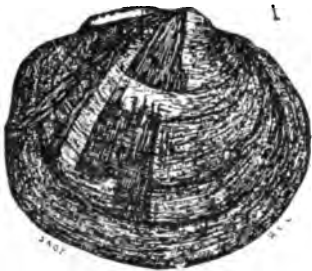


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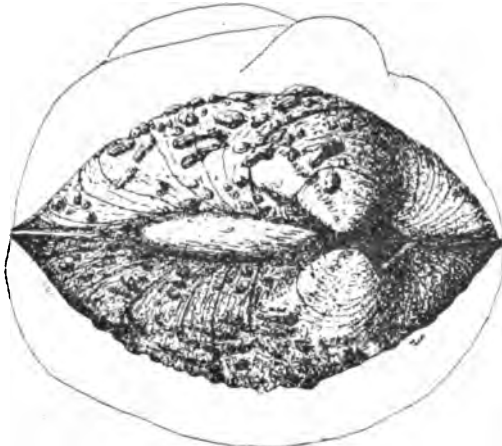
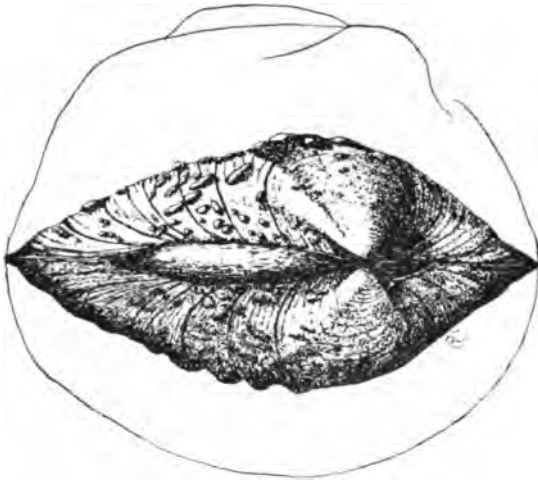
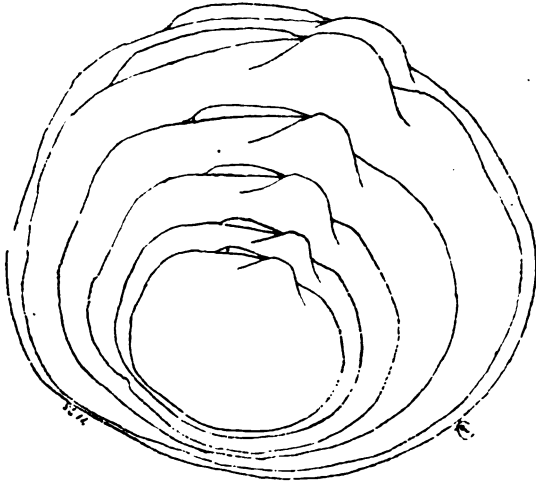
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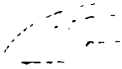


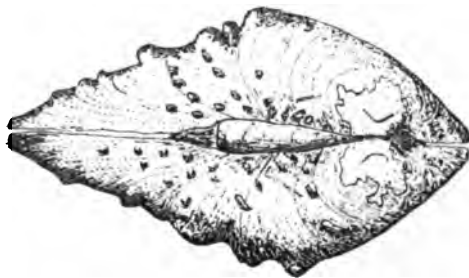
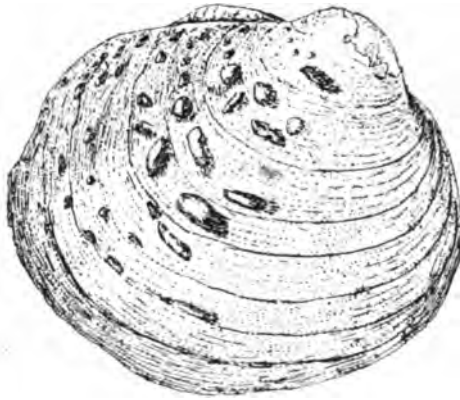
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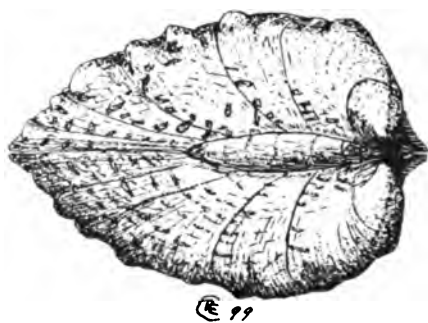


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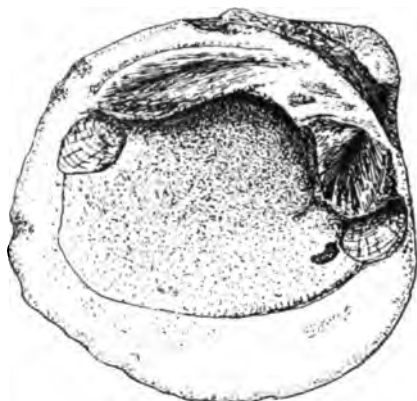




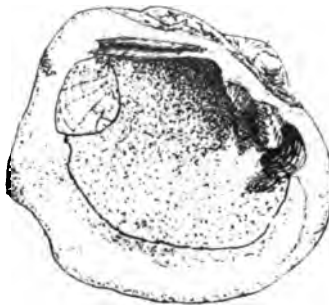
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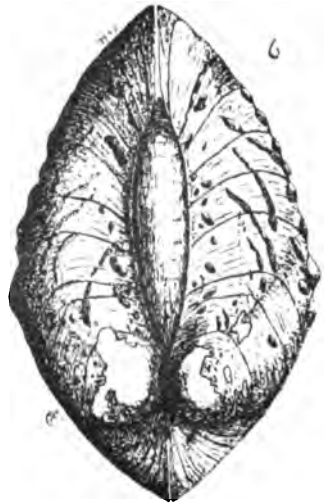
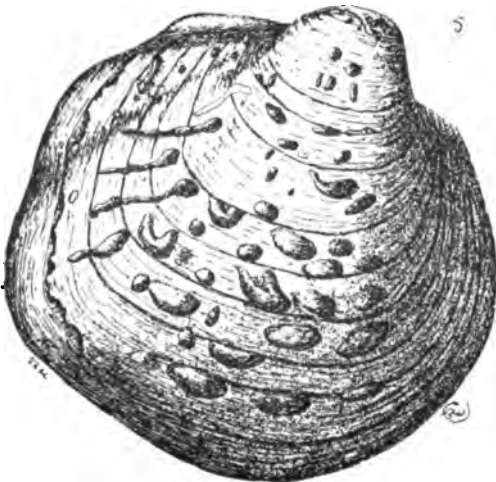
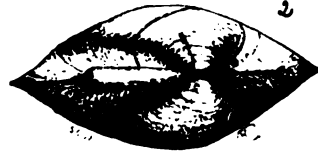
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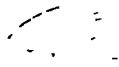
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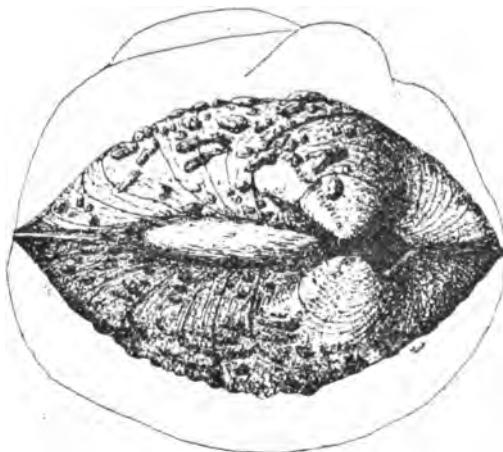
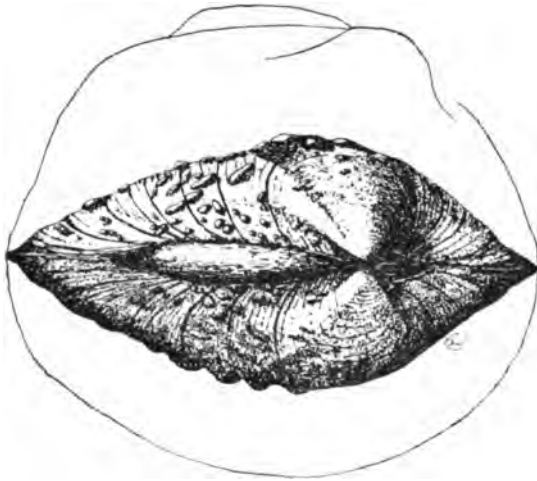
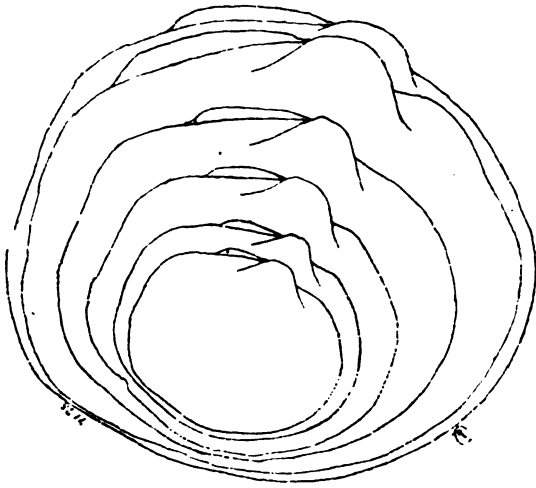


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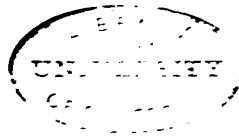


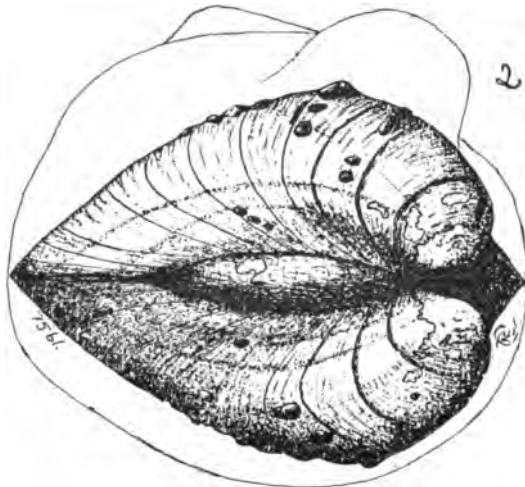
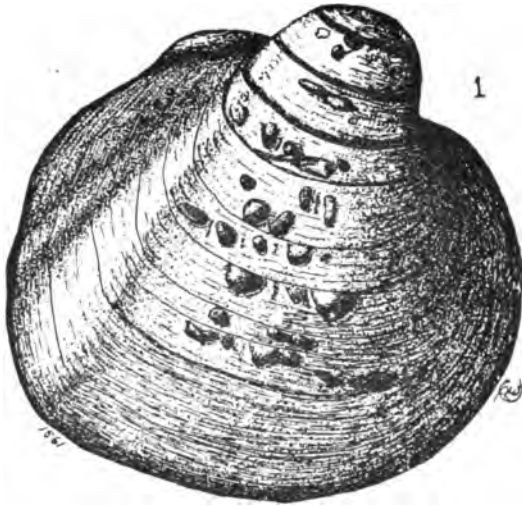
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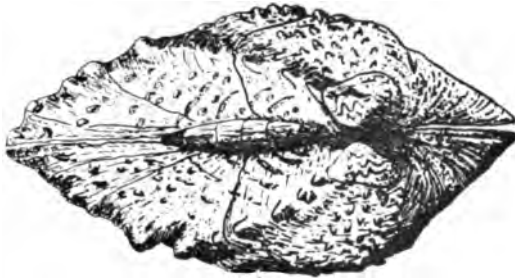
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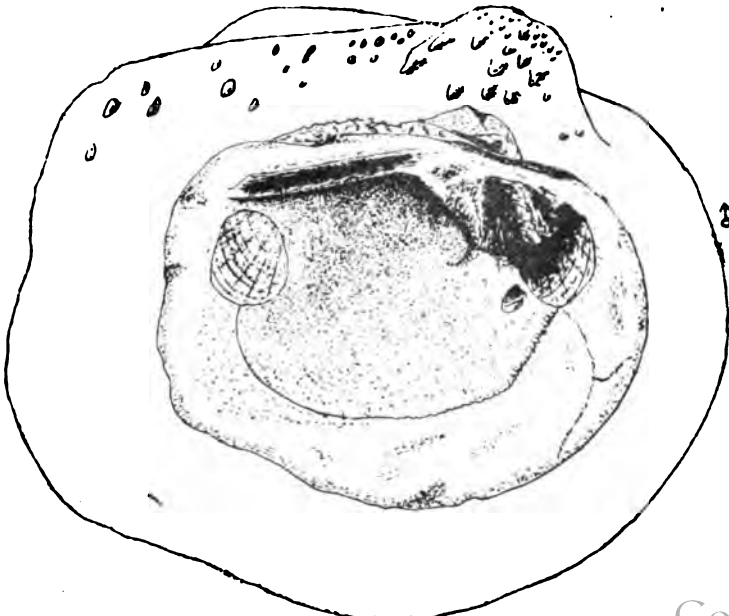


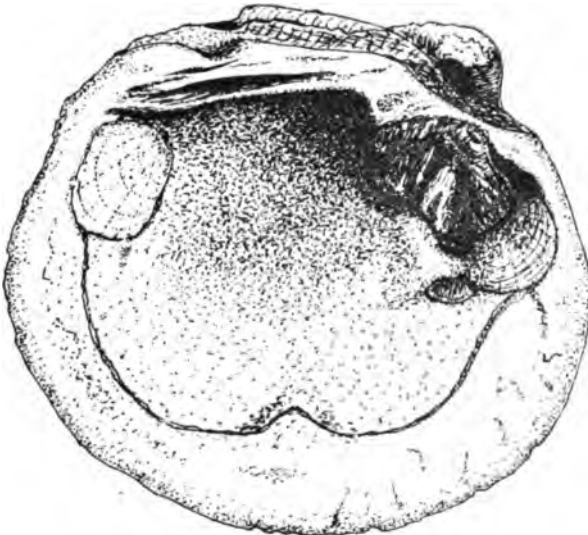
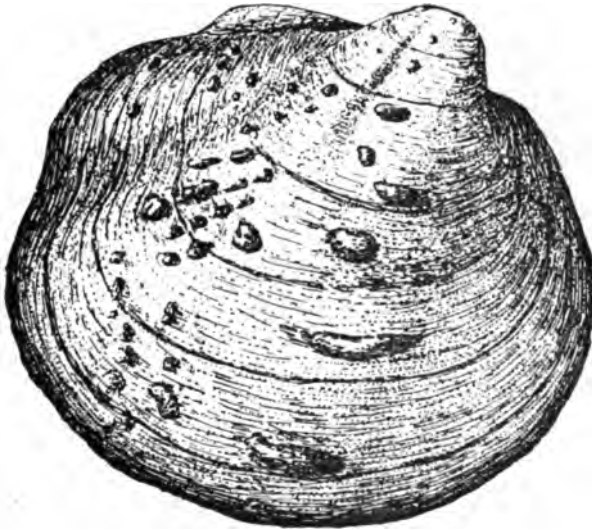
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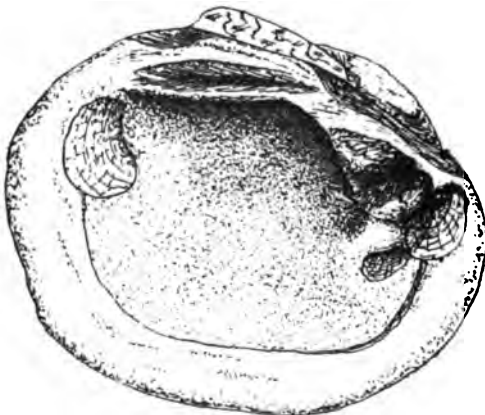
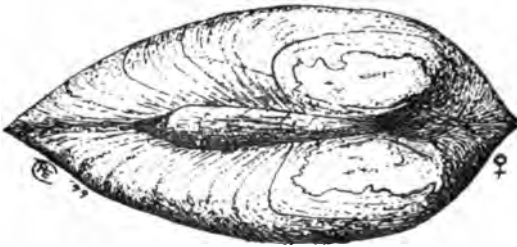
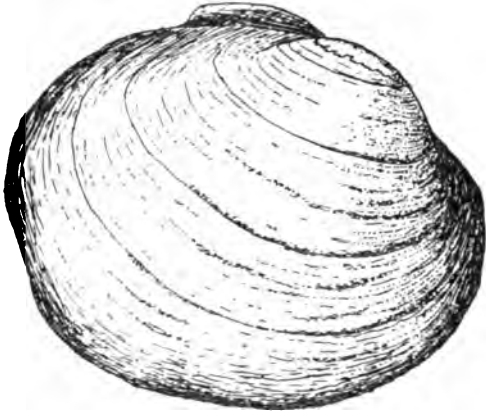
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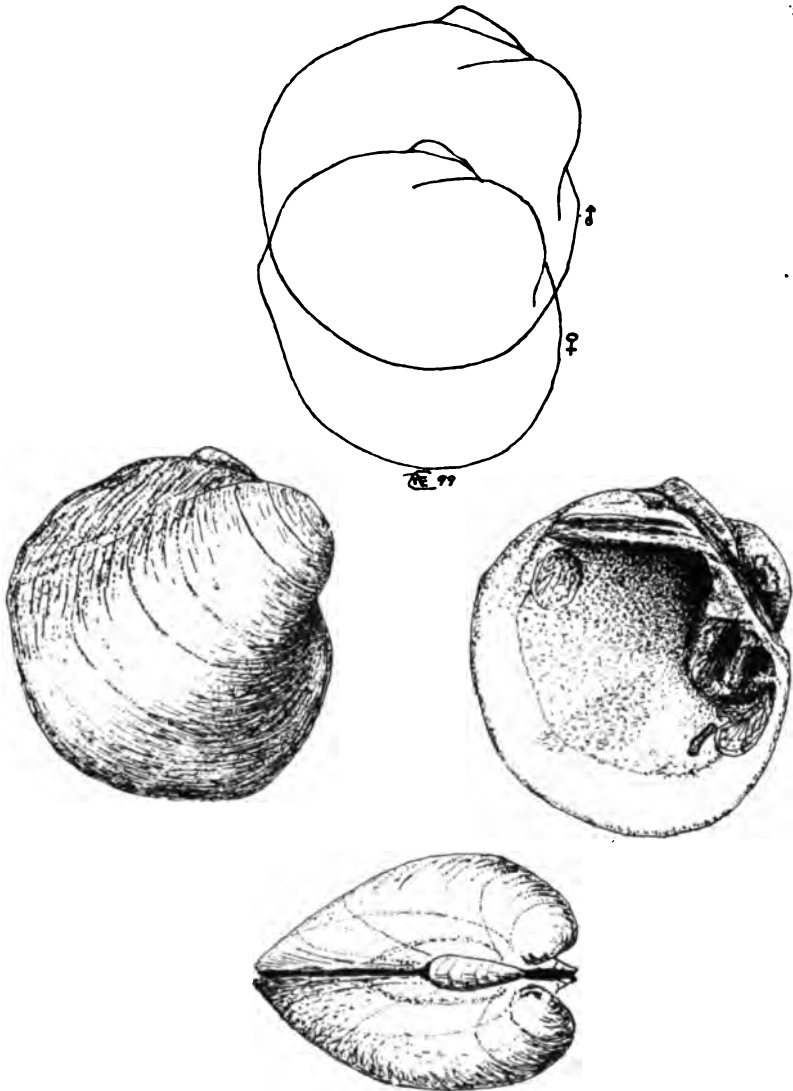


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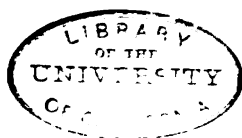
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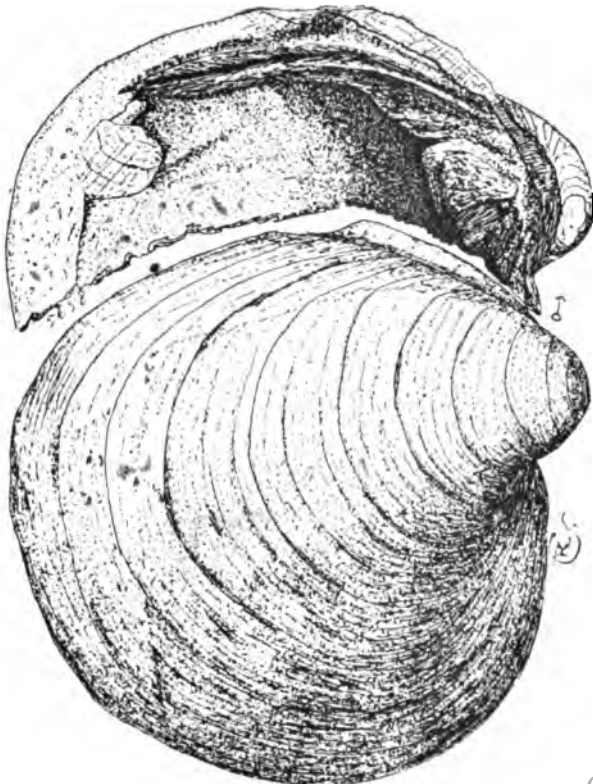
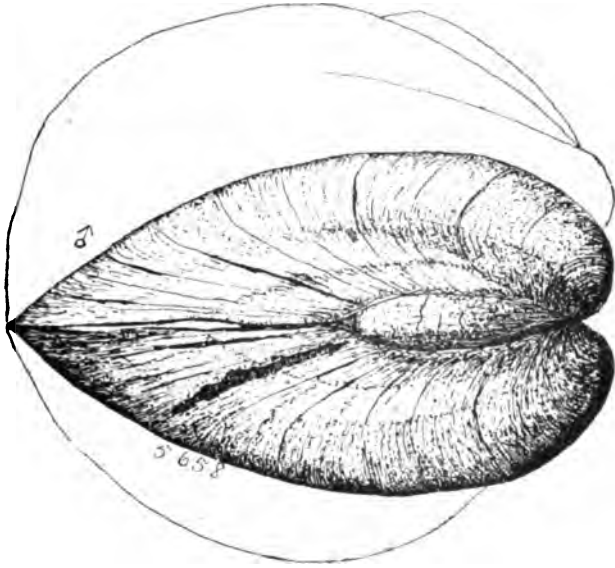


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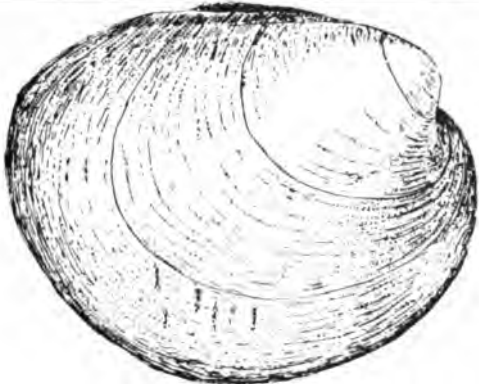


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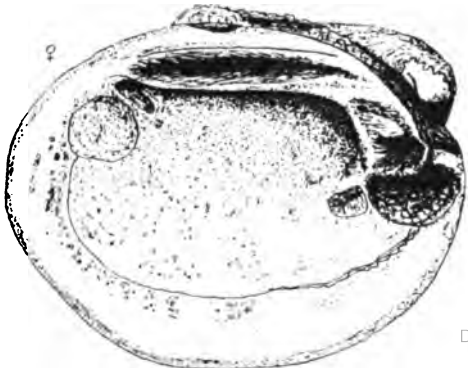
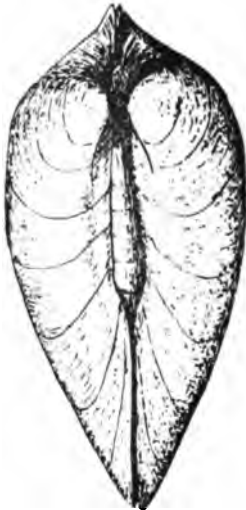
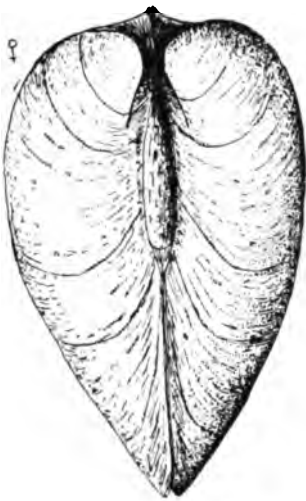




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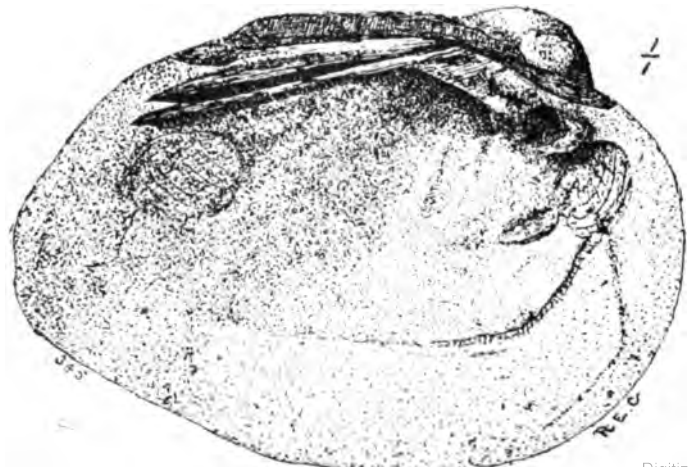
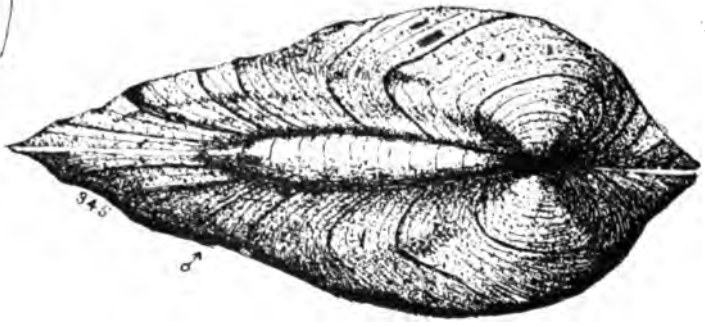
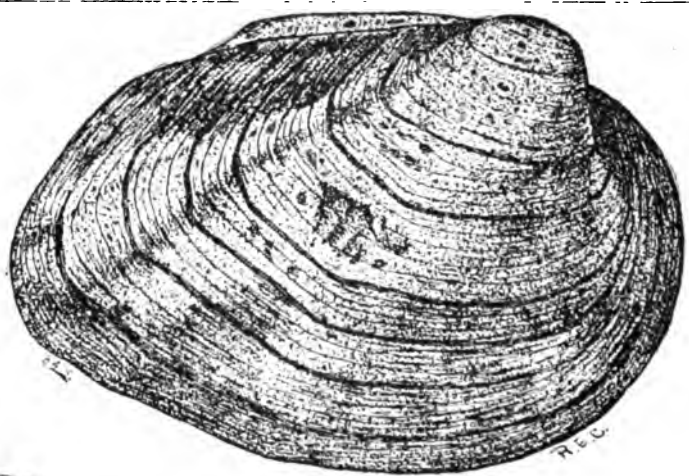


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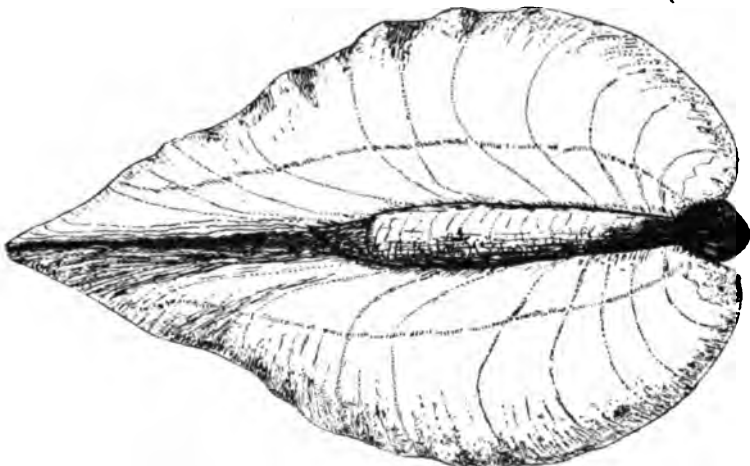
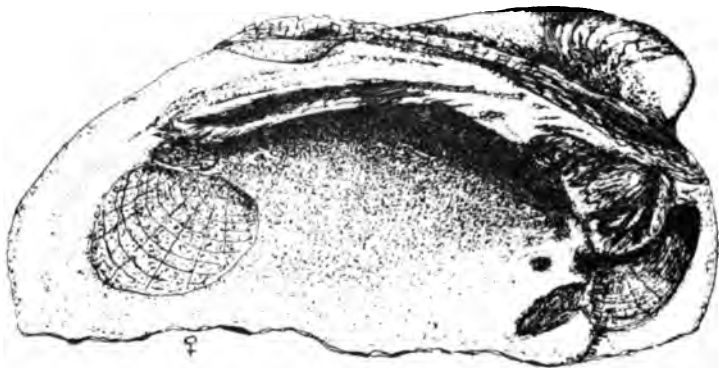
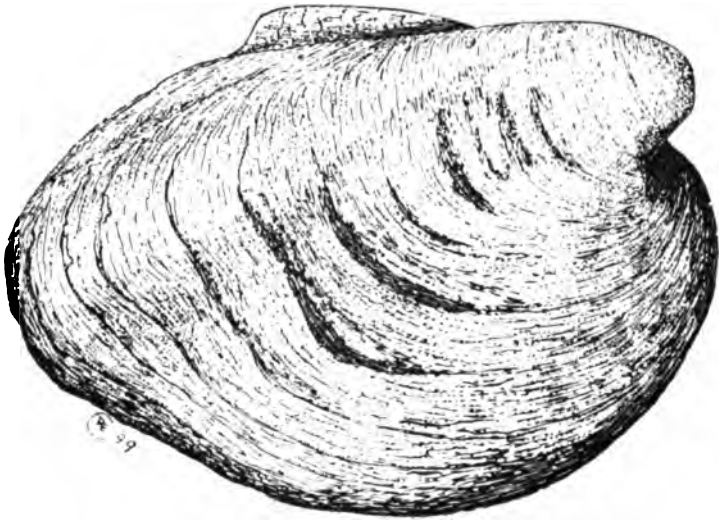
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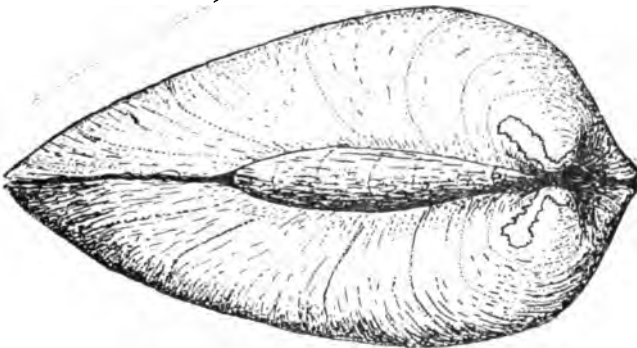
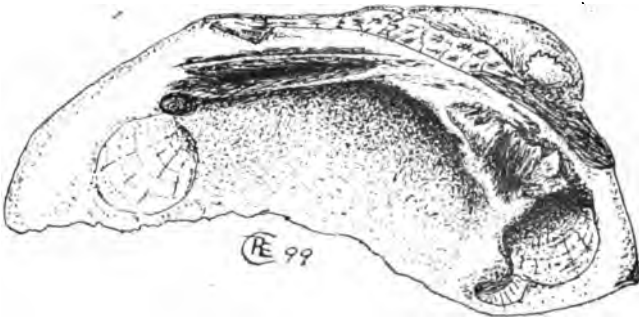
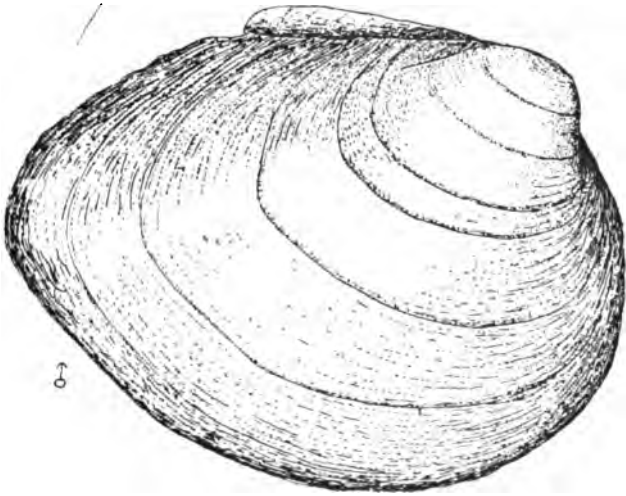


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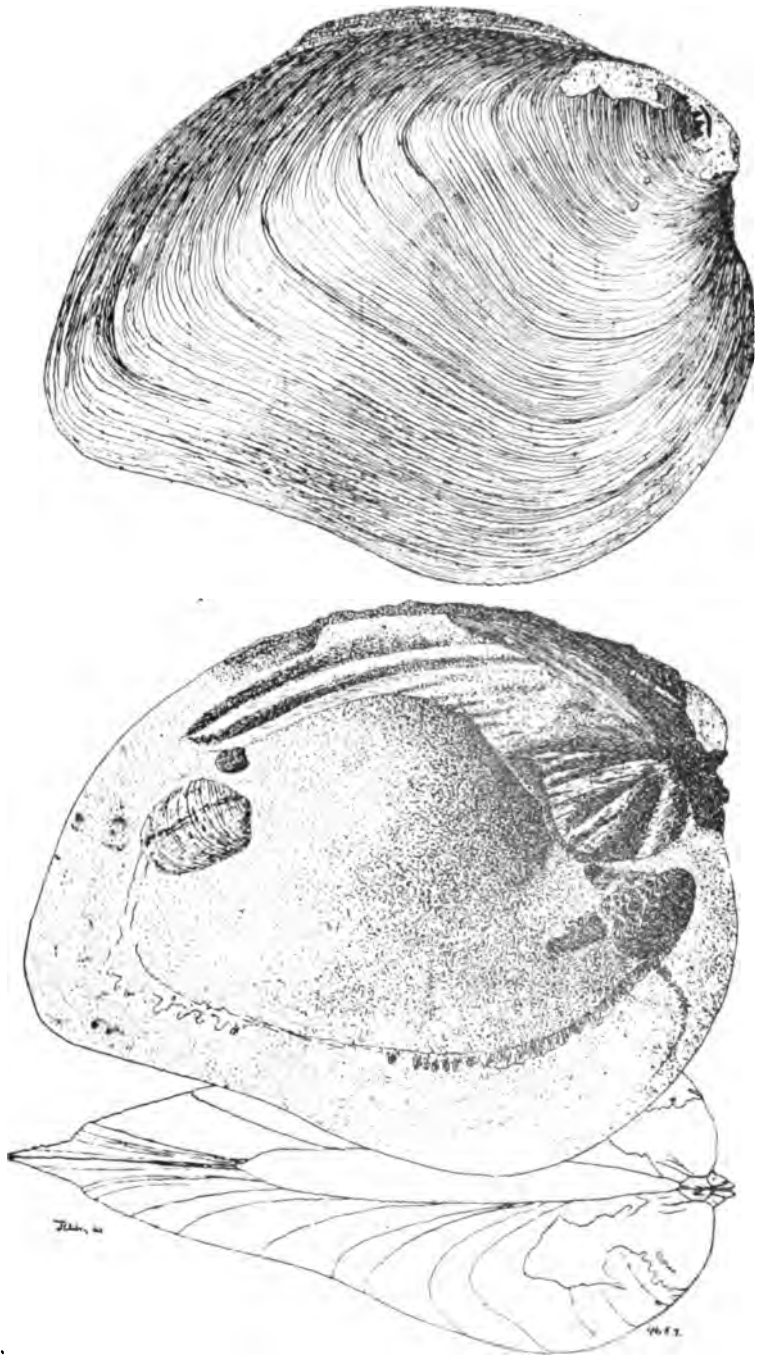




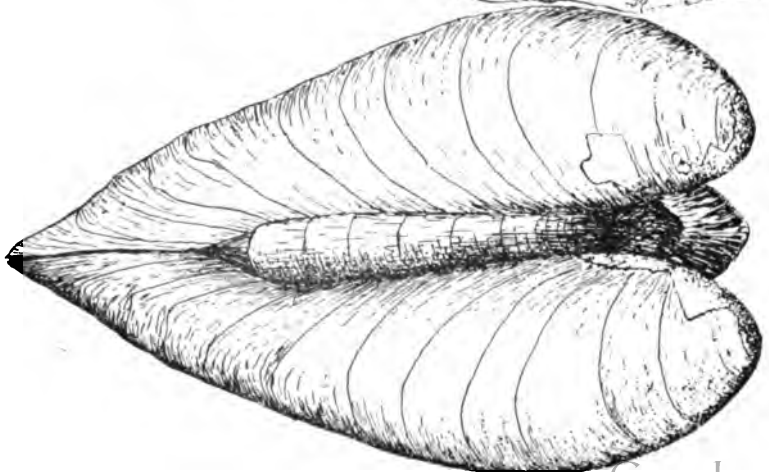
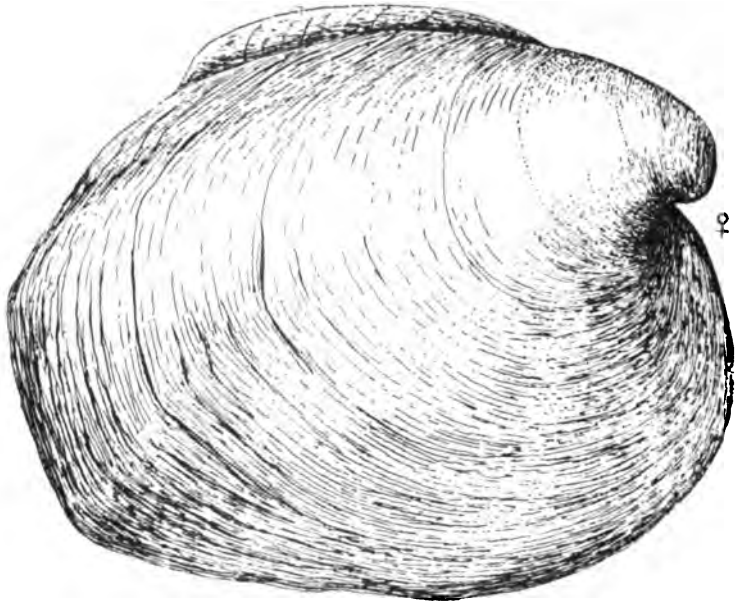
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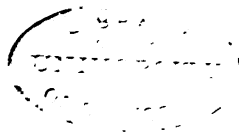


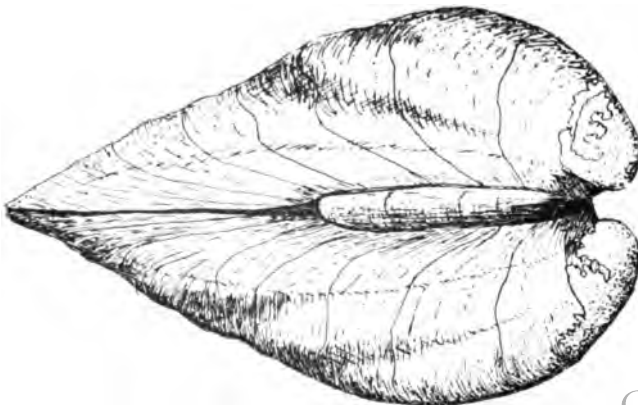
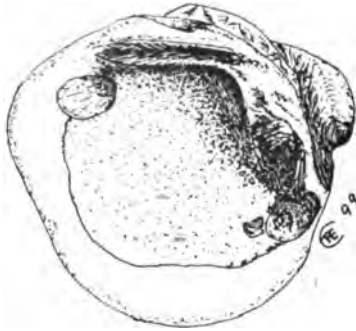
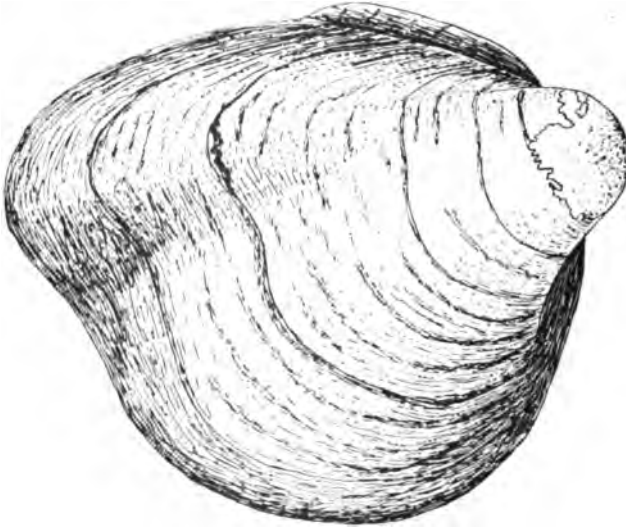
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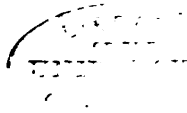
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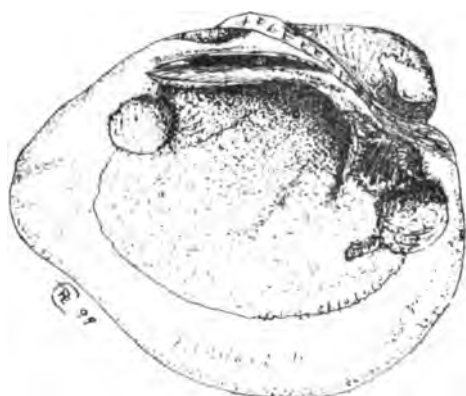
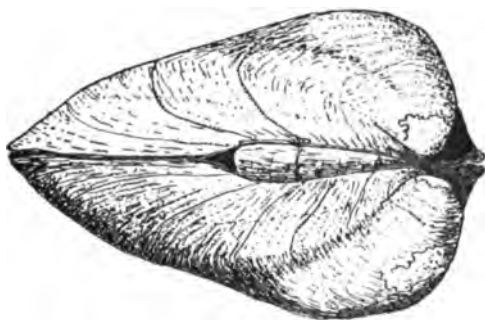
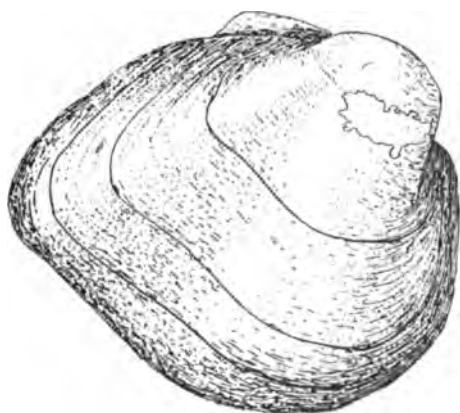




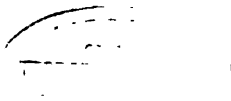


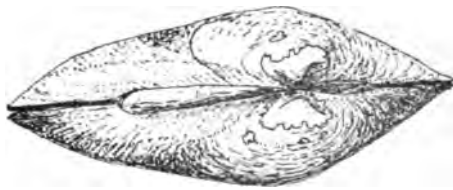
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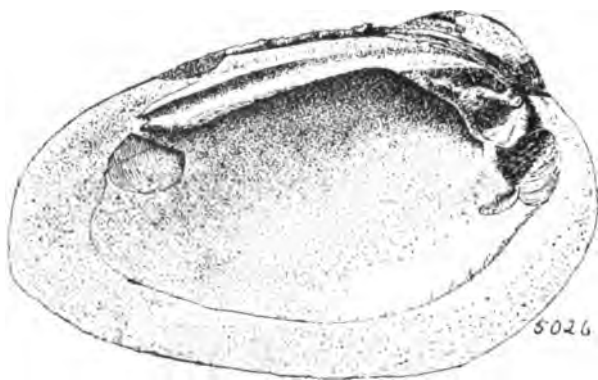
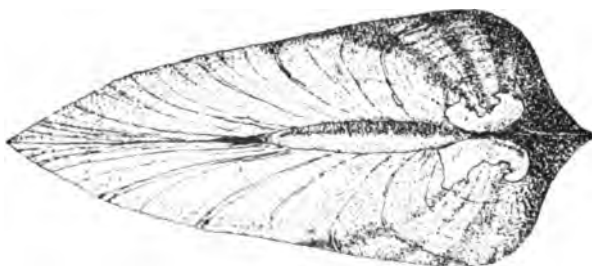
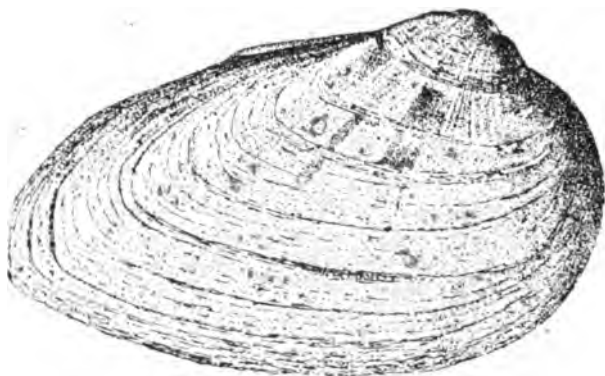


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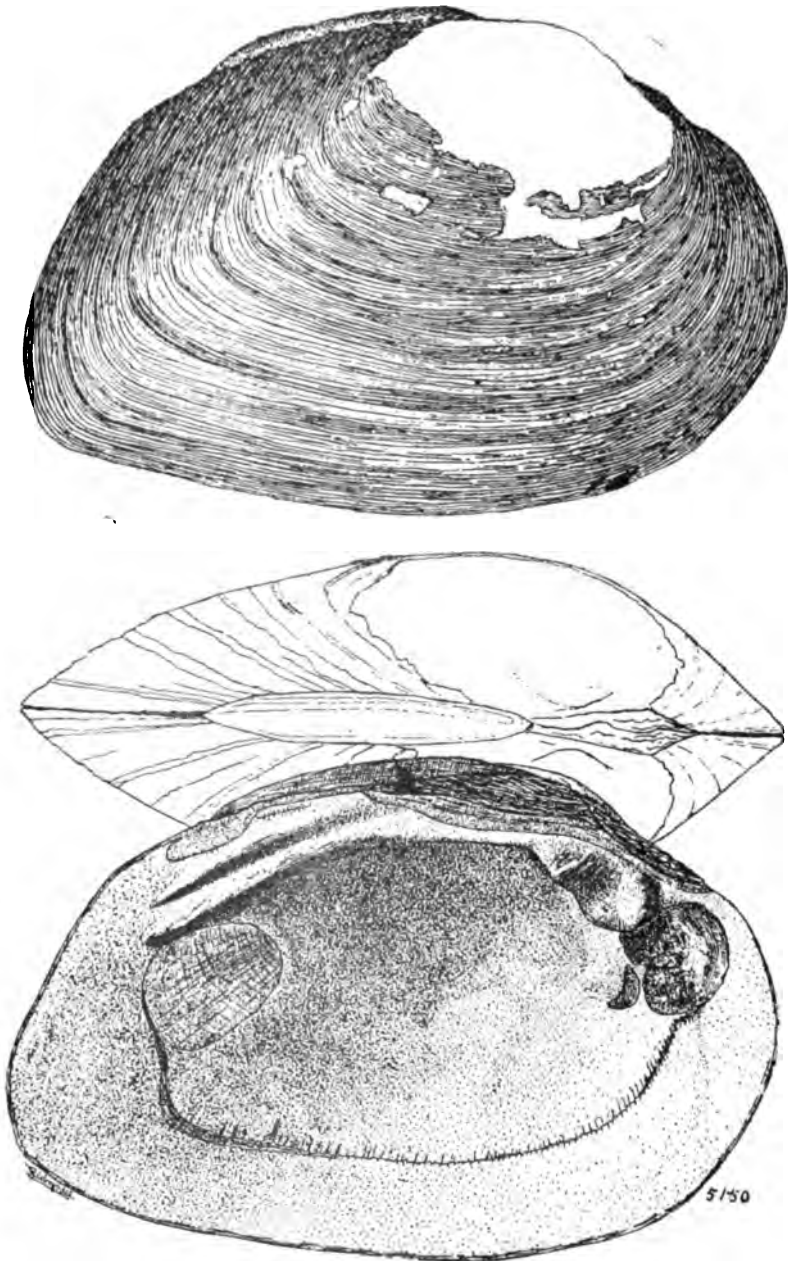




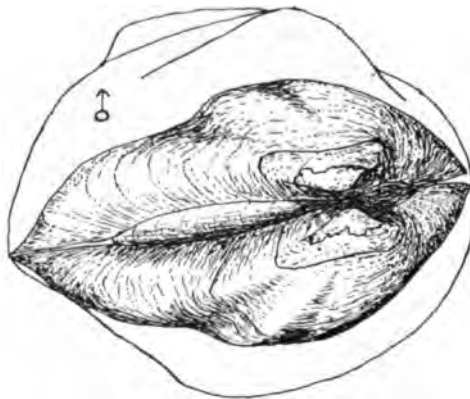
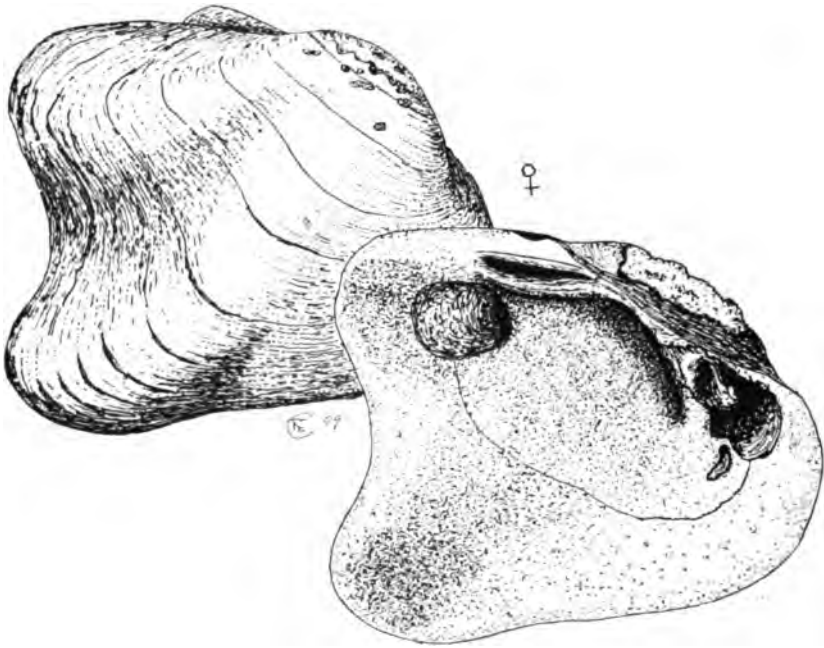
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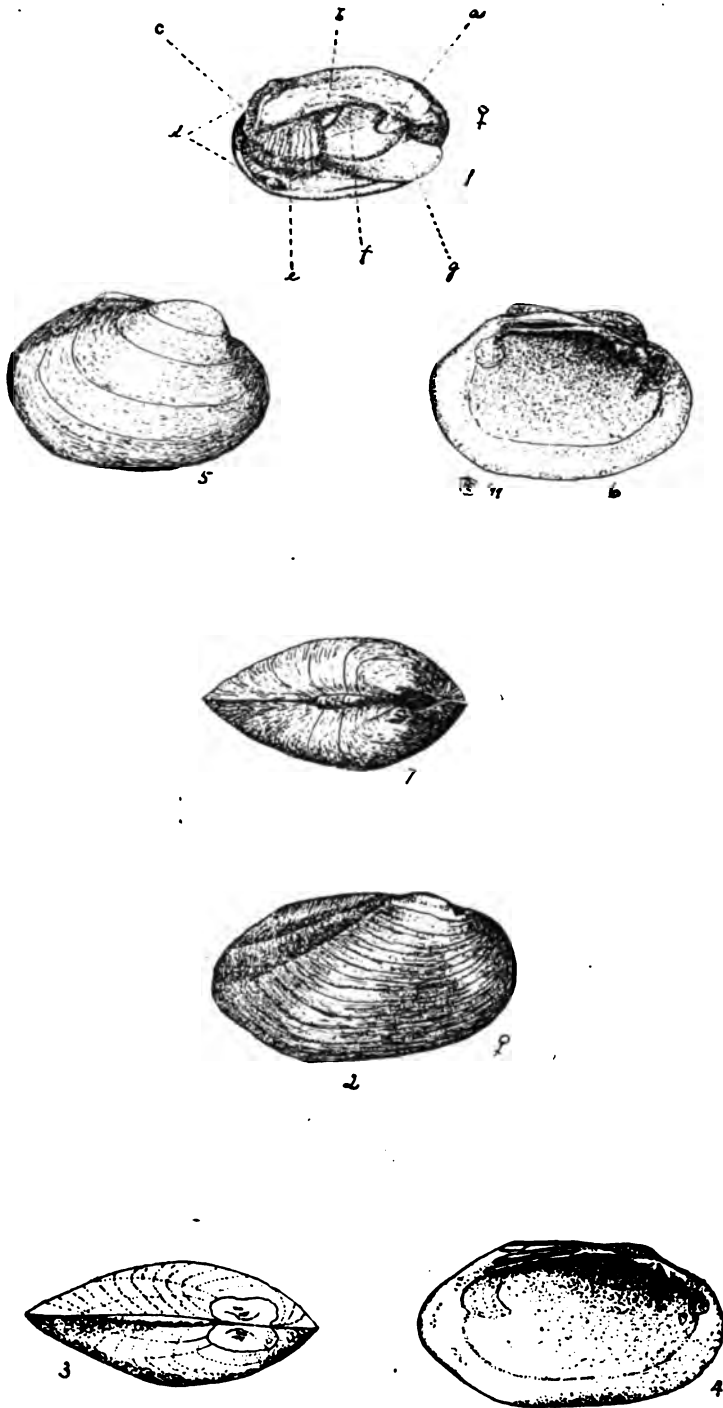
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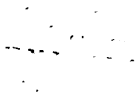
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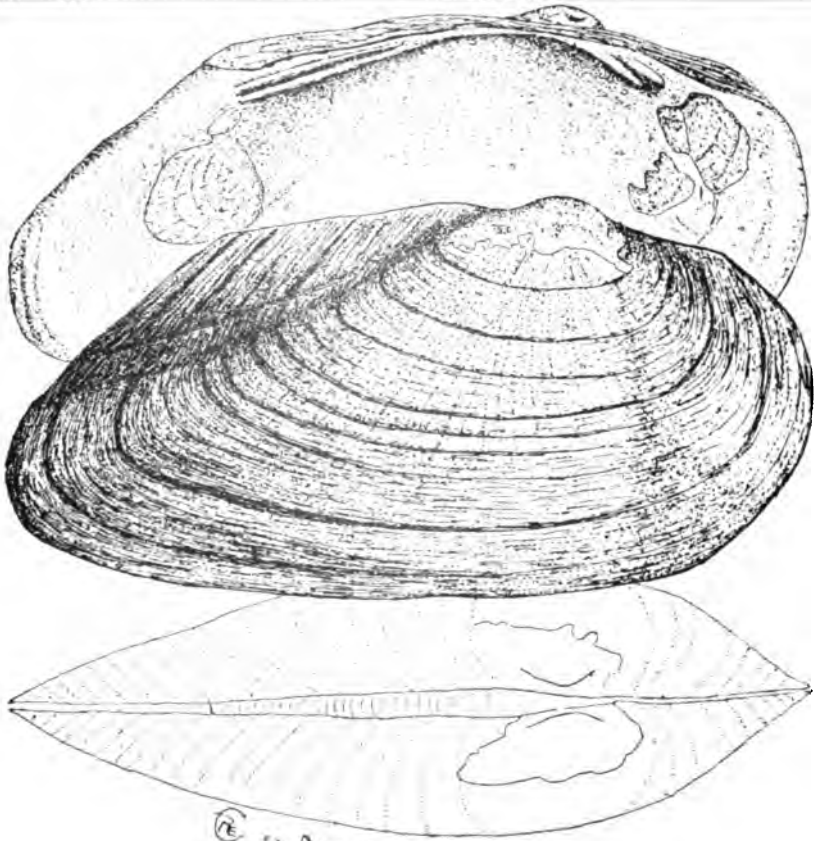


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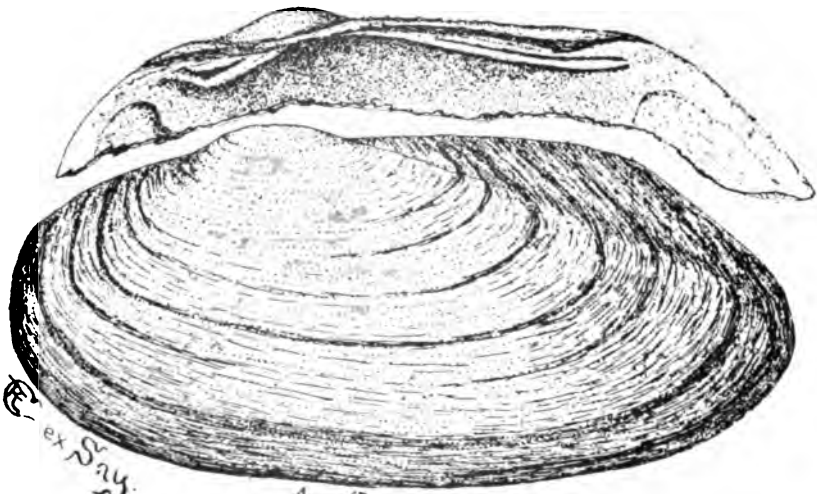
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5-7, UNIO GLANS Lea.





ⓔ ex Conrad.

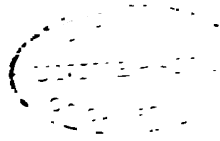
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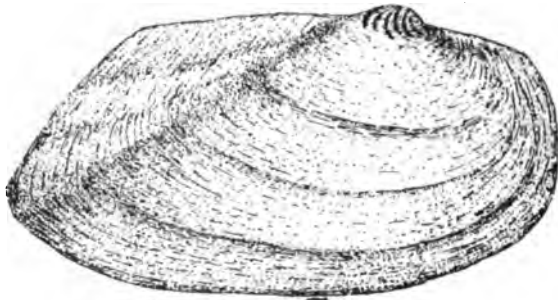


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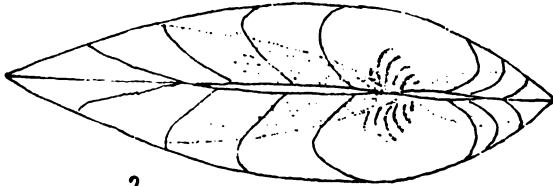
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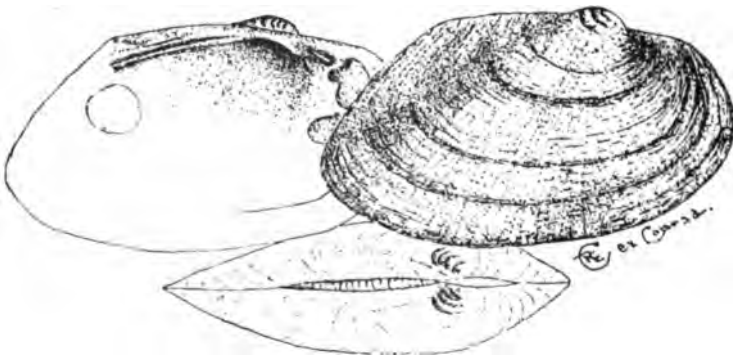




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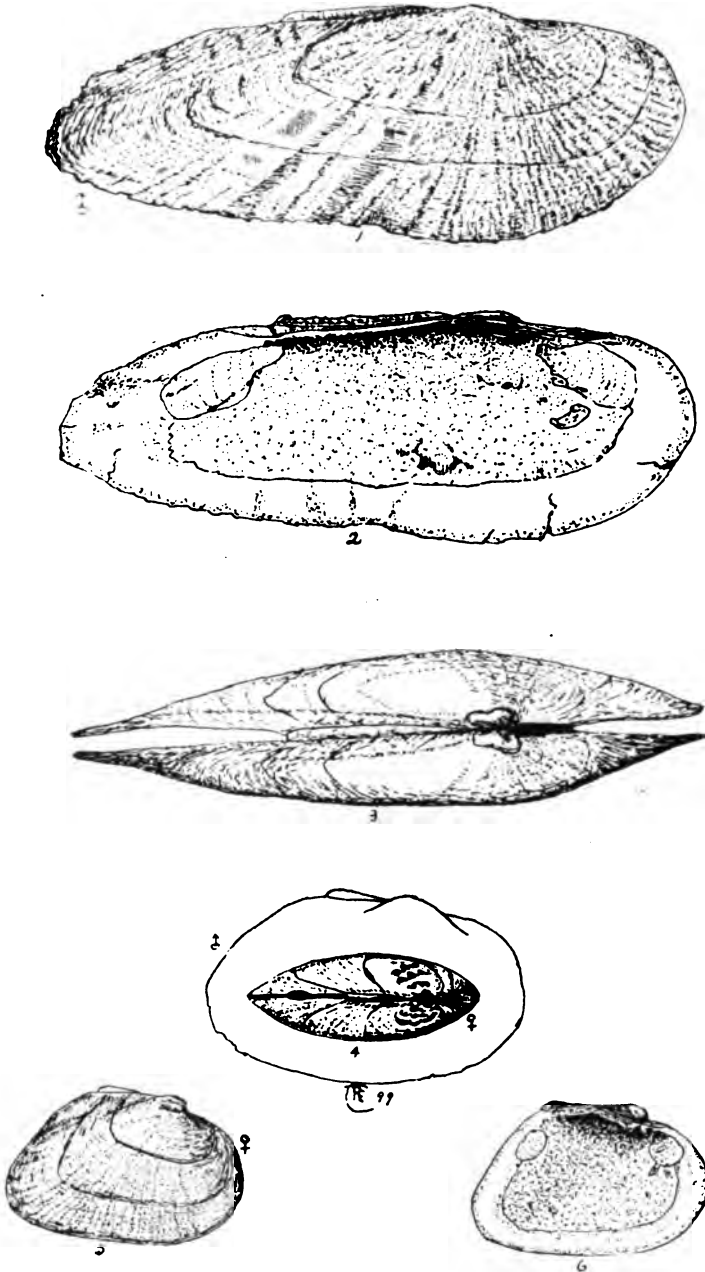
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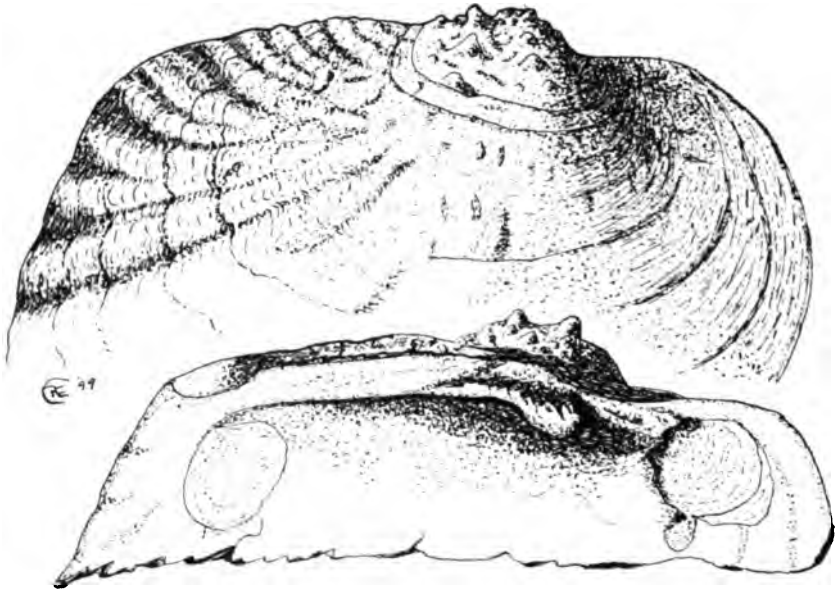
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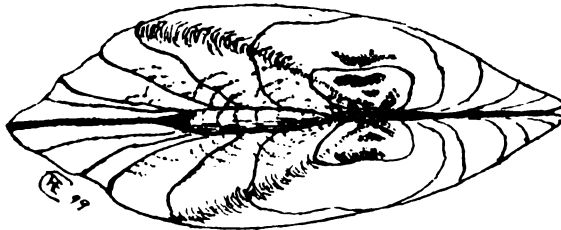
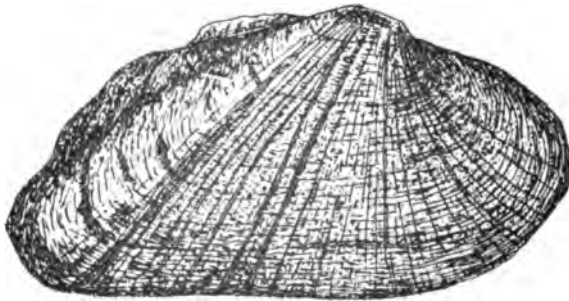




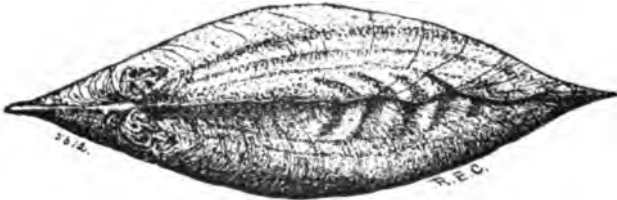
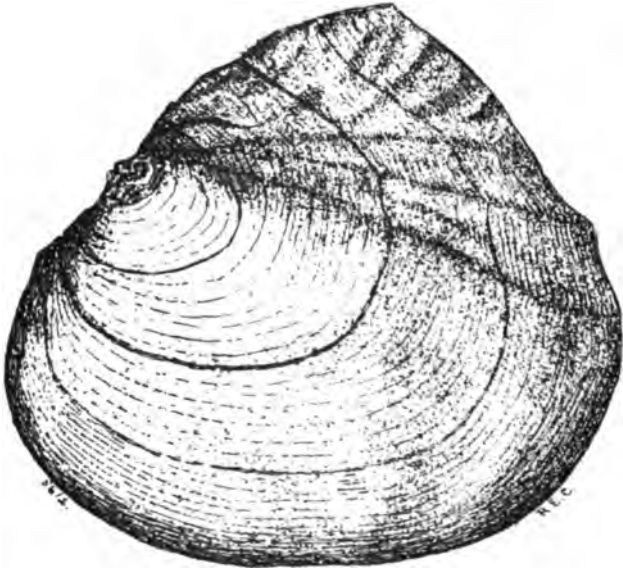
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4-6, MARGARITANA DELTOIDEA Lea.



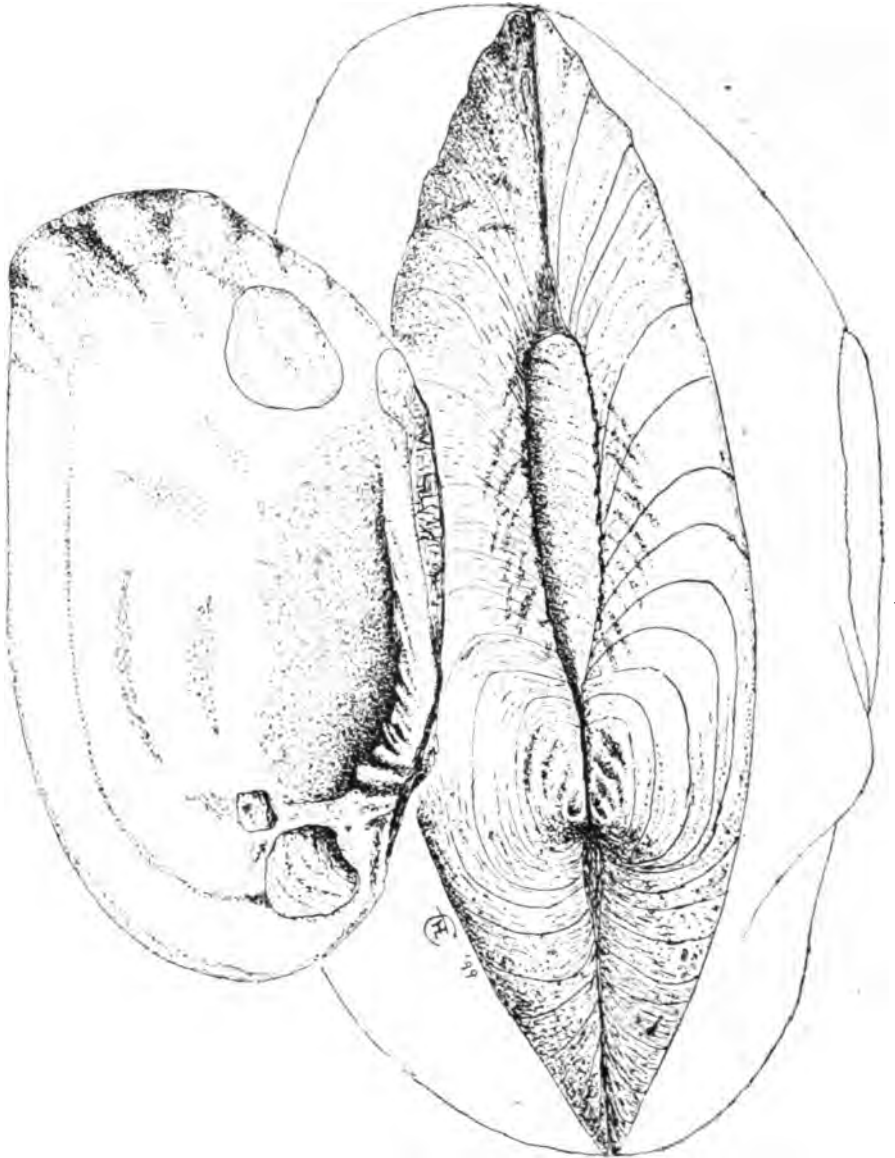
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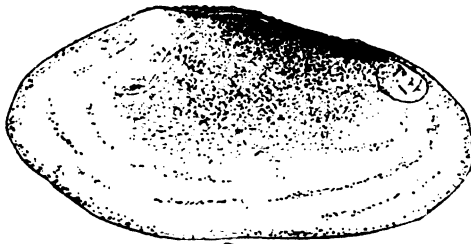
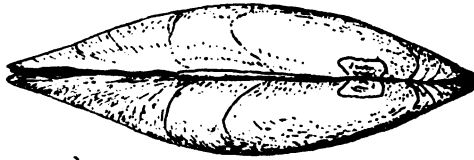
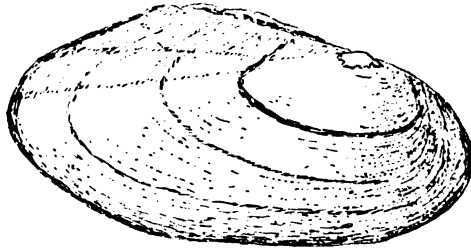


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MARGARITANA RUGOSA Barnes.

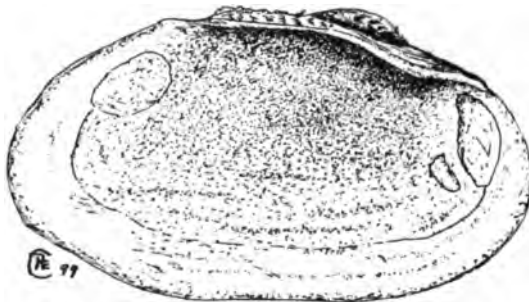
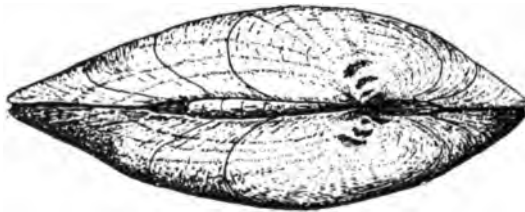
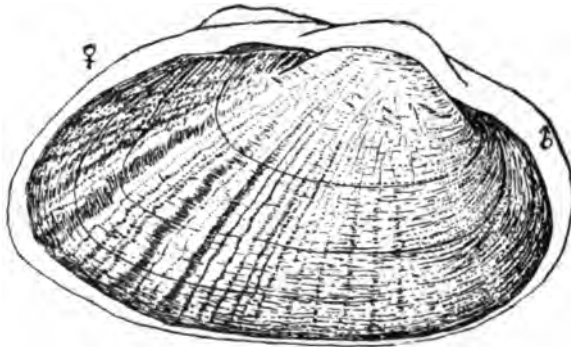




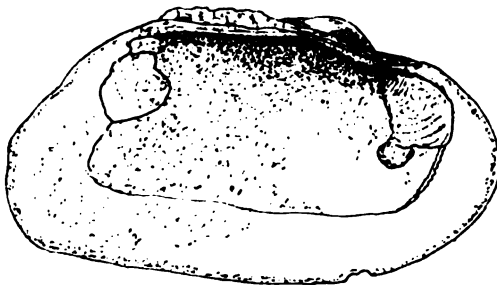
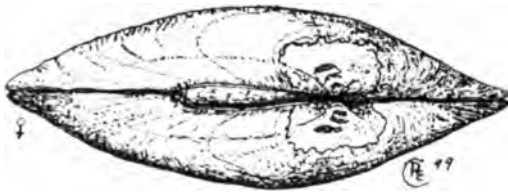
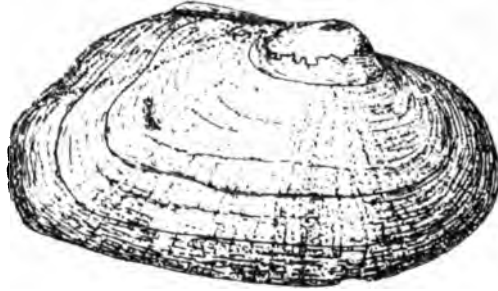
Q 99

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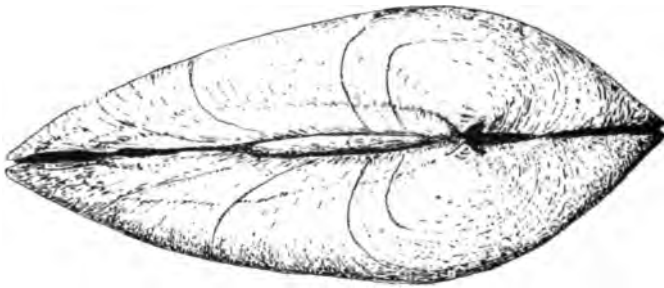
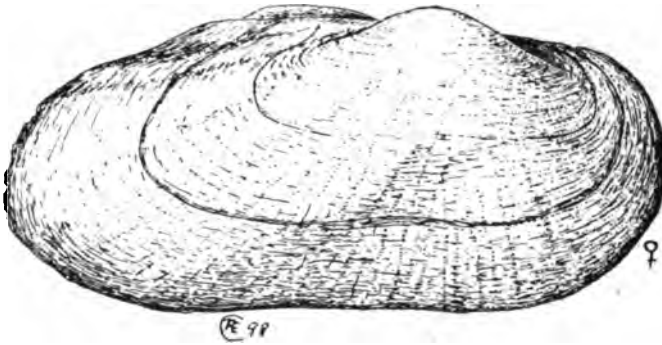
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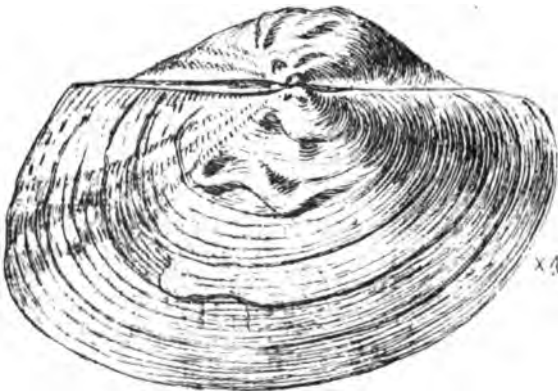
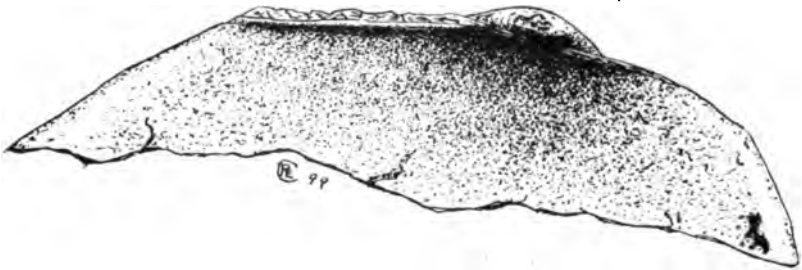
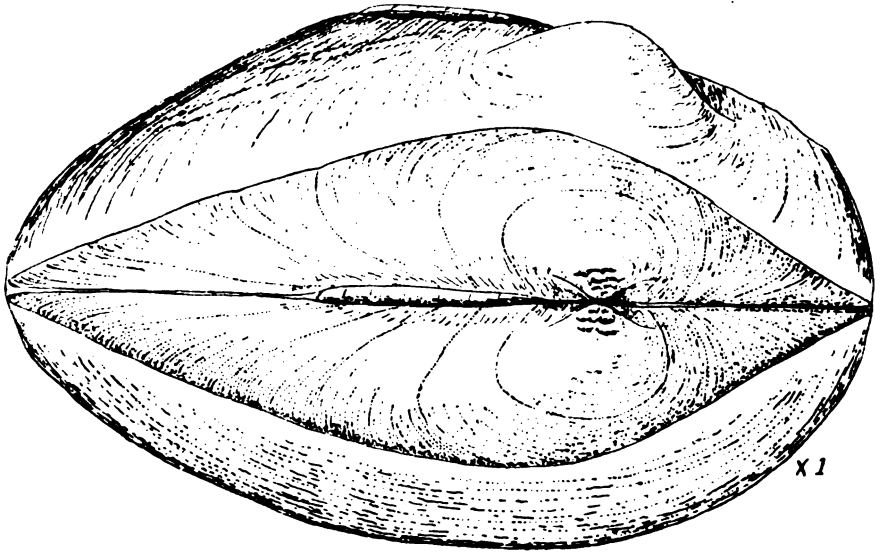
ANODONTA WARDIANA Les.



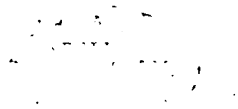
ANODONTA EDENTULA Say.

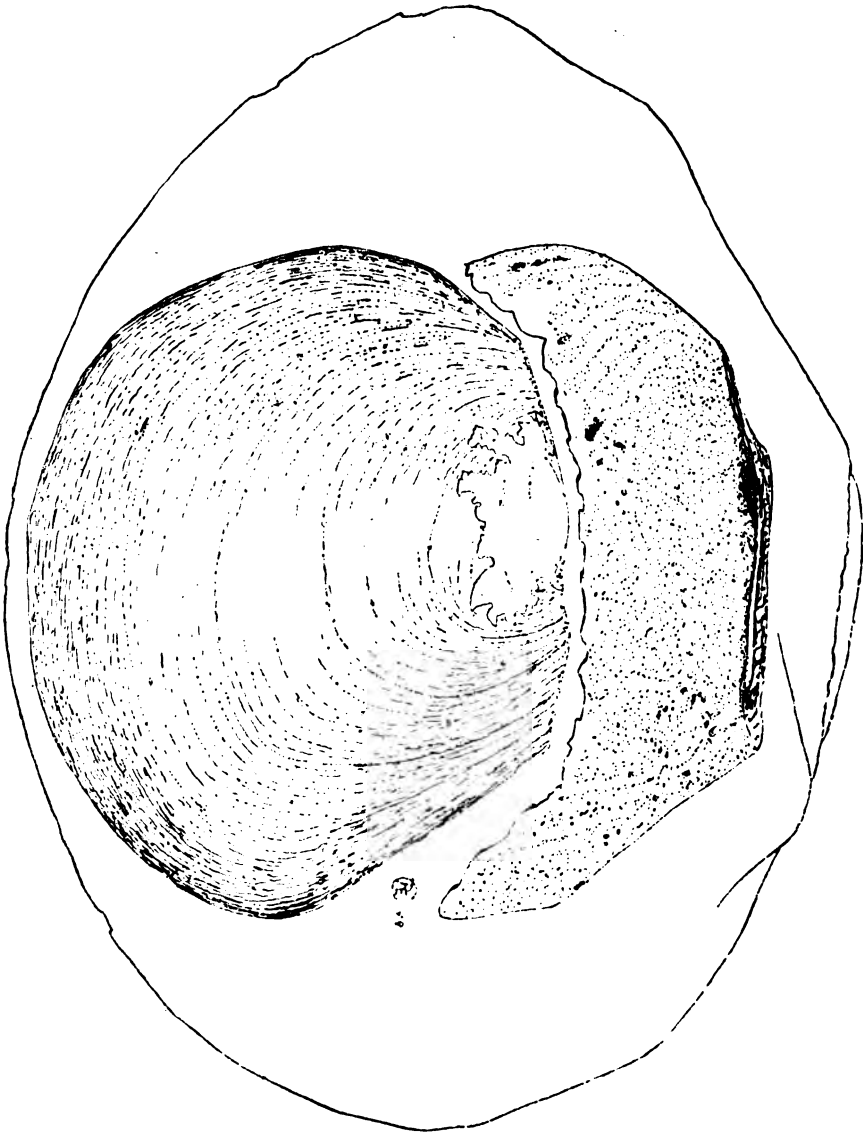


ANODONTA SUBCYLINDRACEA Lea.

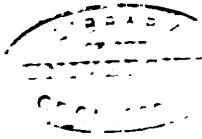


ANODONTA GRANDIS Say.





ANODONTA SUBORBICULATA Say. (Reduced.)



NOTES
ON THE
BATRACHIANS AND REPTILES
OF
VIGO COUNTY, INDIANA.

II.

BY
W. S. BLATCHLEY.

NOTES ON THE BATRACHIANS AND REPTILES OF VIGO COUNTY, INDIANA—II.

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In the *Journal of the Cincinnati Society of Natural History*, XIV, 1891, pages 22 to 35, was published a paper with the same title as the present one. In it were given brief notes concerning 22 batrachians and 24 reptiles which I had taken in Vigo County, Indiana, previous to 1891. I continued to reside in the county until November, 1894, and gave especial attention to the same groups of animals until my removal. Many notes were taken relative to their distribution, variation and habits. A lack of time has heretofore prevented the preparation of a paper embodying these notes. Believing, however, that they will add something of value to the knowledge of our batrachians and reptiles, and will, therefore, be of value to future observers, I have prepared from them the present paper. When the species has been taken by me in some other county of Indiana, I have incorporated any note concerning it in that county which I believed of interest. Species preceded by an asterisk were not mentioned in the previous paper.

Vigo County lies on the western border, and almost midway between the northern and southern boundaries of the State. The Wabash River flows through its northwestern part, and in many places its bottoms, which are usually overflowed each season, are one to two miles in width.

In these bottoms are a number of large ponds, some of them covering an area of forty to sixty acres, which are the favorite resorts of many of the batrachians, and not a few of the reptiles mentioned below. The city of Terre Haute is on the eastern bank of the river, on the edge of a prairie, about two miles in width, beyond which a low range of hills forms the western border of a tableland, which extends to the eastern limit of the county. At the point where the tableland meets the prairie the soil is a loose, black loam, containing a great deal of sand. Here, in a woodland pasture of about forty acres, rather thickly grown up with underbrush, and having near its center several shallow ponds, about the margin of which are numerous logs, have been collected no less than thirty-five of the fifty-two species found in the county. Of course, many of these have been taken elsewhere, but the sandy soil and other conditions of this woods seems to suit the salamanders and tree frogs, especially, as out of eleven species of the former and four of

the latter all but two have been seen here, and nine of the fifteen nowhere else in the county.

The nomenclature and order of the batrachians mentioned is that of Cope's "Batrachia of North America" (*1). The same author's "Critical Review of the Characters and Variations of the Snakes of North America" (*2), has been followed in the naming of the *Ophidia*; while Jordan's "Manual of Vertebrates" (Fifth Edition), has been the authority for the naming of the remaining forms.

BATRACHIA.

URODELA.

AMBLYSTOMIDÆ.

AMBLYSTOMA OPACUM (Gravenh.). Marbled Salamander.

Since my former record† a half dozen specimens of this batrachian have been taken in the county. It is always found singly, whereas other members of the genus are usually found associated together in small numbers. One very large individual had its entire tail wanting. The stub was wholly healed over, and the animal was as lively as any with the caudal appendage entire.

AMBLYSTOMA TIGRINUM Green. Tiger Salamander.

On October 21, 1892, and October 14, 1893, I took my zoology classes to the woodland pasture above mentioned. On each date more than 60 of this salamander were taken. Sometimes four to six were found beneath the same chunk or log. They varied in length from two to twelve inches, and in color from an almost uniform black or dark brown in the young, to largely yellow in the old. On December 24, 1893, a log was overturned in the same pasture, and a large *tigrinum* stuck its head out of the opening of its burrow, presumably to investigate the cause of the removal of its shelter. This goes to prove that their winter days are not passed in a wholly dormant condition.

On one occasion in June my letter carrier brought me in a fruit jar a live specimen 10½ inches in length, which he said had been in his cellar for more than a year. On account of its presence the members of his family had become afraid to venture into the cellar, and he finally pinned the intruder down with a forked stick and worked it into the jar. Its ground color was greenish yellow or olive with anastomosing or reticulating bands of black, 3 to 5 mm. wide, on the sides of body and tail,

*1—Bull. 34, U. S. Nat. Mus., 1889.

*2—Proc. U. S. Nat. Mus., XIV, 1892, pp. 589-604.

†Journ. Cin. Soc. Nat. Hist., *loc. cit.*, p. 24.

and a few rounded spots of the same on the belly. These markings agreed almost exactly with those ascribed to Cope's *A. xiphias*, of which but a single specimen, from Columbus, Ohio, is known. This specimen was sent to Dr. Stejneger, of the United States National Museum, who compared it with Cope's type, and wrote me as follows: "Your specimen represents a color phase of *A. tigrinum*, which resembles very closely the type of *A. xiphias*, but the latter still remains unique in its most distinguishing characters, viz., the exceedingly long tail concomitant with the projecting lower jaw. In *A. xiphias* the tail, measured from the posterior end of the anus, is much longer than from that point to end of snout; in your specimen it is shorter, and the lower jaw is not projecting. * * * It is difficult to express an opinion as to the status of *A. xiphias*. I am strongly inclined to the belief that the type specimen is only an individual variety of *A. tigrinum*. Yet, at the same time, I do not venture to reduce the name to a synonym as long as the gap between them shall not have been filled, or our knowledge of the batrachians of our country is as imperfect as at the present time." Cope, in his key separating the species*, uses the color markings as part of the distinguishing characters separating the two species, so that the Vigo County specimen removes one feature of the "gap" to which Dr. Stejneger refers.

A number of beetles and caterpillars were one day dumped into the box in which the salamanders for class use were kept. A large *tigrinum* nabbed a hairy caterpillar which was crawling over its head, shook it several times, as a terrier does a rat, and then with an air of satisfaction gulped it down.

PLETHODONTIDÆ.

PLETHODON CINEREUS (Green). Ashy Salamander. Red-backed Salamander.

This species and its variety *erythronotus* are the most widely distributed and most common salamanders in Indiana. In Vigo County they can probably be found every month in the year, as on December 25, 1893, two very large specimens of *erythronotus* were taken, which ran actively about when the log beneath which they were hibernating was overturned. On October 6, 1894, beneath logs and chunks on some high wooded hills five miles northwest of Terre Haute, hundreds of the two forms, varying in length from one to four inches, were found. There were about six of the variety *erythronotus* to four of *cinereus*. This salamander has never been seen by me near water, but the eggs have often been found beneath logs and moist leaves between mid-April and June 1.

The nominal variety *dorsalis* Cope, has been taken by both Prof. Hay and myself near Wyandotte Cave, Crawford County. Two specimens

*"Batrachia of North America," p. 51.

taken there on May 9, 1899, were three and one-half inches in length and had 17 costal grooves.

PLETHODON GLUTINOSUS (Green). Slimy Salamander.

I have taken this species in Vigo, Putnam, Marion, Crawford and Marshall counties. On one occasion in late autumn, six large ones were found beneath one chunk on a sloping hillside in an oak woods pasture. One of these had the tail a uniform olive gray without white marks, while the white spots on the sides were coalesced into a large lichen-gray patch. In another the white spots were no larger than pin heads and were distributed thickly and regularly over the entire upper surface and sides.

SPELERPES BILINEATUS (Green). Two-lined Triton.

Since my former paper this has been found to be frequent in the ravines among the wooded hills of Coal Creek in the northwestern part of Vigo County and very abundant in Putnam County. In the latter locality it was found by scores in early spring—March 22—and in August, beneath the flat limestone rocks of a branch. In the former place, in October, when all the pools were dry, it was found on the moist clay, beneath rocks and boulders. When its shelter was overturned it scampered away in a lively fashion, and endeavored to burrow in the mud or leaves. When in rapid motion upon land it wriggles its body and tail, as if swimming, thus proving its aquatic habits.

***SPELERPES LONGICAUDUS** (Green). Long-tailed Triton.

Two small specimens were taken in Vigo County on September 20, 1894. A number of large ones were found associated with *S. bilineatus* in Putnam County in August. In both places they were in small pools of water beneath rocks in the bed of a branch. In the State it has been recorded heretofore with certainty only from Montgomery and Harrison counties. Specimens of *S. maculicaudus* were in my possession from Monroe County as early as 1884, six years before it was named by Cope, but, without specimens for comparison, were thought to be and labeled *S. longicaudus*.

PLEURODELIDÆ.

DIEMYCTYLUS VIRIDESCENS MINIATUS Hallow. Red Triton.

This variety, which Cope regards as a "seasonal form which may be, by reason of the environment, rendered permanent for a longer or shorter time," has been taken on a number of occasions in recent years. It is usually found beneath logs or brush in *very dry* places. One was taken on December 24, 1893, which was very active when its cover was disturbed. Another was dredged from a woodland pond on March 14.

It has also been taken in the months of May and October, while a single specimen of the form devoid of red spots, described in my former paper, was taken on September 27, 1893.

TRACHYSTOMATA.

SIRENIDÆ.

SIREN LACERTINA Linn. Siren. Mud Eel.

On June 20, 1894, I visited the site of a large pond in southern Vigo County, which, having been drained the fall before, was being plowed for corn. Walking in the furrow behind the plowman, I happened upon a siren, which I captured. I then waited until the plowman caught up with me on the next round, when he said that he had unearthed "thousands of them" during the plowing of the sixty or more acres already broken. I had little cause to doubt his word, as, following him five times around, I captured eight of the batrachians, varying in length from six to sixteen inches. The plow broke the soil to a depth of five inches, and as none of those taken were injured by the plow, they were evidently above this depth, probably three to four inches below the surface. Most of them were wriggling like worms in the furrow when discovered, but one was taken from a burrow, or hole, in a large clod. The sides of this burrow, which was but little larger in diameter than the body of the siren, were worn smooth, and were bluish gray in color. It had evidently extended down deeper into the ground, but I could not find at what point. The animals were found in the moister ground plowed, and not in a sandy strip which had to be passed over. The gills of none were fully developed, being merely slightly lobed excrescences covered with skin without rami or branches of any kind. When put into water (at home) they were very active, but came to the surface to breathe. The plowman said that I could have gathered them "by the bushel" from the moist land already broken, but that he had noted none over 15 inches in length, though he had given no especial attention to them.

Although the siren is reputed to be very scarce, there is little doubt but that it is plentiful enough in certain localities which are suitable to its habits of life. Atkinson records* the taking, in late autumn, of 11 in one bunch, which were uncovered while cleaning a lot near Syracuse Lake, Kosciusko County.

*Proc. Ind. Acad. Sci., 1895, 258.

SALIENTIA.

HYLIDÆ.

*ACRIS GRYLLUS GRYLLUS (Le Conte). Cricket Frog.

After the draining of the large pond, noted above under *Siren lacertina*, thousands of tadpoles and small frogs were left for a short period in some shallow pools. From these a number of cricket frogs were secured on October 8, 1893, which I refer to this variety. They were smoother skinned, a fourth larger in size, and with the stripes on hind femora much more distinct than in the variety *crepitans*, which is abundant throughout the State. *A. g. gryllus*, as limited by Cope, is a southern form, but has been taken at Mt. Carmel, Ill., about fifty miles below the pond mentioned.

CHOROPHILUS TRISERIATUS (Wied.). Swamp Tree Frog.

A number of specimens of this little frog have been secured in recent years. One was found on December 25, 1893, hibernating beneath a rail in open woods. It was squatted in a little burrow, and though the mercury had previously been to zero, it leaped away in a lively manner when touched. Others have been secured in May, September and November from beneath logs or under the bark of fallen trees.

The heel of all Vigo County specimens reaches only to the tympanum. The width of head is contained in total length 3.5 times. The stripes of back and sides are often broken up into small dots or blotches.

On the tall grasses near the margin of a tamarack swamp in Fulton County, I found a variety of this same frog to be plentiful. It is more slender-bodied with all the stripes unbroken and with heel reaching to posterior border of orbit. This form I take to be *C. feriarum* Baird.

HYLA PICKERINGII (Storer). Pickering's Tree Frog.

This handsome little tree frog has been taken by me in Vigo, Putnam, Fulton, Lake and Marion counties. It is often found at quite a distance from water, on stalks of wheat or weeds. On March 13, 1898, one was taken from the surface of a woodland pond in Marion County, to which it had evidently found its way for the purpose of ovipositing.

HYLA VERSICOLOR Le Conte. Common Tree Frog.

On July 5, 1892, I found in the woodland pasture, mentioned in the introduction, hundreds of the young of this species, on the leaves of the iron weed—*Vernonia fasciculata* Michx. Almost every weed had two or more individuals on it. They were resting on the upper surface of the leaves, and their colors were correspondingly green.

RANIDÆ.

**RANA AREOLATA CIRCULOSA* Rice and Davis. Hoosier Frog. Ring Frog.

After hunting in vain over most of northern Indiana for this species, which heretofore has been recorded in the State only from Benton County, I was agreeably surprised to have Charles Stewart, one of my pupils, bring in a large male on October 9, 1893. He had captured it and a specimen of *Rana virescens* Kalm the day before from the manhole of a sewer in the south part of the city of Terre Haute. The female of *circulosa*, which escaped capture the first day, was taken on the second day after by letting a basket down into the manhole and causing her to jump into it. On May 9, 1894, a second male was taken by H. McIlroy from the side of a coal shaft three miles west from where the others were secured. These are the only specimens I have ever seen, but others could doubtless be found by a careful search of similar locations.

The ring frog is the most handsome of our *Ranidæ*. The male, of those in hand, is 67 mm., and the female 78 mm. in length. The head of female is 25 mm. long by 26 mm. wide. The heel reaches half way between eye and nostril. The tympanum is three-fourths the diameter of eye. Instead of being uniform yellowish below, as mentioned by both Cope and Hay, both specimens have numerous small dark spots, almost forming a band, across the front of breast, and on the lower lips are a number of similar spots. Otherwise the colors agree exactly. The circular spots on back, from which it takes its varietal name, and which Cope says are reddish brown, are in life black.

REPTILIA.

OPHIDIA.

COLUBRIDÆ.

**CARPHOPIOPS AMENUS* (Say). Worm Snake. Ground Snake.

Two specimens of this little snake having both prefrontals present have been taken in the county. They measure respectively 11 and 11½ inches in length. Both were taken in autumn; one from beneath a rotten log on the top of a high wooded hill—the other from beneath leaves by the side of a log in the sandy woods, noted in the introduction to my former paper. It is more sluggish and apparently more fearless than any of our larger snakes, making no attempt to escape when exposed to view and, beyond twisting tightly about one's finger, no attempt at defense when taken in hand.

Cope unites with *amœnus* the form without prefrontals, which I called *C. heleneæ* Kennicott in my former paper (p. 35); having, as he states, seen

individuals with one prefrontal present. Of two specimens without prefrontals before me from Vigo County, the head is more slender and pointed and the color of back darker than in the typical *amœnus*. The abdomen in life was also of a deeper salmon red than that of *amœnus*. One of them has on one side but one scale—a large crescent-shaped scute—in the second row of temporals. On the other side there are two normal scales present. These specimens were taken from beneath logs and measure respectively nine and one-half and seven and one-half inches.

Two specimens without prefrontals and with slender pointed snout were taken near Wyandotte Cave, in Crawford County, on May 9, 1899. One was coiled up beneath a flat rock and had its head hidden beneath the coils, so that I took it at first to be a large earth-worm. It was freshly moulted and was a lustrous purplish black in color, instead of chestnut brown as in the typical *amœnus*. This color extended down the sides to cover all but one and one-half rows of scales. *C. vermis* (Kennicott) with prefrontals present, is distinguished from *C. amœnus* chiefly by the difference in color, being iridescent purplish, as was the specimen mentioned above. In typical examples of *vermis* this color is said to extend on each side only to the third row of dorsal scales. A large series of specimens will probably show *C. vermis* to be but a color form of *C. amœnus*.

OPHIBOLUS DOLIATUS TRIANGULUS (Boie). Milk Snake. House Snake.

Several small specimens of the milk snake are annually taken from beneath the loose bark of logs and stumps, while the larger ones appear to become scarcer every year. Cope in his recent paper separates a form known as *clericus* Baird and Girard, which he states is found only southward, from *triangulus* by the position of the alternate spots on the sides, stating that in the former variety they are largely on the gastrosteges, while in the latter they are entirely on the scales. The specimens in Vigo County, according to this, mostly belong to the form *clericus*, though the spots merge into each other in every conceivable way.

*OPHIBOLUS DOLIATUS COLLARIS Cope.

One large and three small specimens from this county in my collection possess the yellow band posteriorly from orbit and the yellow half-collar touching occipitals, which distinguish this variety. According to Cope it has been known heretofore only from "the Carolinian district." Some of the forms of this species when disturbed, or held by the forward part of the body, vibrate the tail very rapidly, after the manner of the rattle-snake.

OPHIBOLUS GETULUS SAYI (Holbrook). King Snake.

Three specimens of this handsome snake have been taken in the county. One is the small specimen with narrow cross bands of white, noted in my first paper. Another is three feet four inches long and approaches closely the form *niger* of Yarrow. The yellow spots on head are few in number and no larger than pinheads. Those on the body are of the same size and are found only occasionally near the middle portion of the body on the three or four lower lateral rows of scales, while the dorsal portion of body and tail, as well as sides of latter, are shining black without spots.

The third specimen is but twelve inches long and approaches the typical *O. getulus* in that the cross bands of white have a tendency to fork on the flanks. This specimen was taken on May 27, and has protruding from its mouth four and one-half inches of the tail of a specimen of *Eutania sirtalis*, 13½ inches in length, the remaining nine inches being within the body of the king snake, and reaching to within one inch of the vent of the latter. When captured, it tried to disgorge its prey, but the *Eutania* was too deeply lodged, and the two were quickly consigned to a bottle of alcohol, there to serve as a forcible illustration that the king snake is truly a king and a cannibal among its kind.

I have also seen this species in Putnam County, Indiana. It frequents rocky hillsides and the vicinity of streams.

***OPHIBOLUS CALLIGASTER (Say). Chain Snake.**

A single specimen, 34 inches long, was taken June 10, 1893, in an open woods two miles east of Terre Haute, at a point where the prairie meets the upland. It was crawling slowly over the ground and did not quicken its speed when pursued, though it struck rather viciously when caught. This, I believe, is its first Indiana record. Cope gives its range as "Illinois and Kansas to Texas." Garman states that in Illinois it "occurs on prairies throughout the State—not common."

DIADOPHIS PUNCTATUS (Linn.). Ring-necked Snake.

According to Cope, this species is distinguished from *D. amabilis* Baird and Girard, by having eight instead of seven labials, and by having the labials, throat and belly unspotted, or the belly with a median row of spots, whereas in *amabilis* the throat, labials and belly are irregularly spotted.

Of the three specimens in my collection two were taken in Vigo County and one in Putnam County. The latter and one of the former are, as far as color goes, typical *punctatus*, having the labials and throat unspotted and with traces of a median row of spots upon the belly; but the superior labials are in both seven on one side and eight on the other. The larger of the two is 14¾ inches in length.

The third specimen is the one which in my former paper I called *Diadophis punctatus amabilis*. It has the superior labials also 7 + 8, but has the labials and throat spotted, the occiput collar very narrow and a median row of spots on belly complete to anus. The lateral spots on gastrosteges are quite large and toward the anus meet the median, forming bars across the belly. I conclude, therefore, that the two are but color forms of one species, and I believe that the species *amabilis* will not stand. The Putnam County specimen, taken on July 10, 1894, was found beneath some flat limestone rocks on a damp, shady hillside. It appeared neither active nor vicious, but, when captured, coiled up contentedly in my hand. In life the belly was a very bright orange.

From the same hillside, in the latter part of September, 1898, Mr. J. S. Michaels took from the dirt thrown out from a quarry, eight eggs and one young of this species. The eggs were placed in a tool box and most of them hatched within a week. The young were about five inches in length and very lively.

COLUBER OBSOLETUS Say. Pilot Snake. Black Racer.

Several of the young of a *Coluber*, which I refer to this species, are in my collection from Vigo County. They are from 14 to 20 inches in length, and vary much from the adult in characters other than size. The scales are in 25 rows with only about nine of the median rows faintly keeled, whereas in full-grown specimens the number of keeled rows is 17. One has the temporals 3 + 2, the others 2 + 2. All have the ground color, ashy gray. A curved U-shaped, blackish band extends over the hind margin of post-frontals, the lower post-oculars and the seventh and eighth labials. There is a row of squarish, chocolate colored spots—about 45 in number—along the back. Below these, on each side, are two rows of similarly colored blotches, the upper more or less elongated, especially in front; the lower squarish or irregular in shape on side of abdomen and partially covering the first and second row of scales. The vertical and occipital plates bear also some small dark spots.

Of five specimens, which I found unlabeled in the State Museum, three have the temporal plates 2 + 3 and the others 2 + 2. The third temporal varies much in size and position. In two instances it is small and wedged in obliquely below the upper plate and back of the lower one. In the other the upper temporal is divided into two equal plates. The carinated scales are in nine or eleven rows. The upper row of lateral blotches also varies much. In one specimen they are united anteriorly into a long line. The markings of the head, however, are constant.

In color and markings all these young agree almost exactly with the description of *Coluber conifinis* as given by Baird and Girard,* and the

*Cat. Serpt., N. Amer., 1853, 76.

first one taken was labeled as that species. *C. obsoletus* is, however, a common snake in Vigo County, and no other young have been seen or taken which could belong to it. On the other hand, *C. confinis* is, according to Cope, a southern form, with but one temporal on each side. It is my opinion that a careful examination of a large series of specimens will show that *C. confinis*, as well as *C. spiloides* Dam. Bibr., are but forms, perhaps the young, of *C. obsoletus*. In fact, the young of most if not all of our dark colored snakes are spotted, and as they grow older and shed their skin a number of times, they gradually grow darker, until finally they become almost wholly black.* This has, in the past, been the cause of much confusion in the naming of the reptiles, many of the young having been thought to be distinct species.

One of the young of *C. obsoletus*, 16 inches in length, taken June 11, 1894, contained a large shrew, which was partially digested.

EUTÆNIA SAURITA (Linn.). Ribbon Snake.

In proportion to its length, this is our most slender-bodied snake. The largest of numerous examples at hand is 29 inches long—the tail nine and one-half inches. Its superior labials are seven on one side and eight on the other, the second from the rostral being divided. When freshly moulted this is a very handsome reptile.

EUTÆNIA PROXIMA (Say).

This is the *E. faireyi* B. & G. of my former paper. It is closely allied to *E. saurita* (Linn.) and a large series of specimens will doubtless reveal all intermediate forms. In *saurita* the sides below the lateral stripes are dark brown, shading to lighter for about the width of two scales on the gastrosteges. In *proxima* the sides below the lateral stripes are black with the greenish of gastrosteges abrupt. The length of two specimens at hand is sixteen and one-half inches each, the tail five and one-half inches. Superior labials 8 + 8. Less common than *E. saurita*.

EUTÆNIA SIRTALIS (Linn.). Garter Snake.

According to Cope, five varieties of this species are to be looked for in Indiana, viz.: *graminea* Cope, *semifasciata* Cope, *sirtalis* (L.), *ordinata* (L.) and *obscura* Cope. The last three have been taken in Vigo County, and in addition a fourth, which, in my former paper, was called *parietalis* (Say).

Of these, *E. s. sirtalis* (L.) is by far the most common. In all specimens of this variety examined the lateral stripes are on the first, second

*This is especially true of *Bascanion constrictor* and *Ophibolus getulus sayi*, and, as shown above, also *Cotuber obsoletus*. The form *niger* of *Heterodon platyrhinos* has never been seen by the writer in the juvenile stage, though hundreds of the young of the more common form have been noted. *Niger* is, therefore, we believe, but a mature form of the species. The same is probably true of the form *niger* of *Ophibolus getulus*.

and third rows of scales, instead of on second and third as mentioned by Baird and Girard. The lower stripe becomes a greenish blue after immersion in alcohol.

E. s. ordinata is scarce, but two small specimens having been taken.

E. s. obscura is a form without dorsal spots. In Vigo County specimens the dorsal band is greenish yellow and the gastrostegees are greenish with two black spots on each margin. In Indiana this form has heretofore been recorded only from Wabash County.

Cope, *loc. cit.*; states that *E. s. parietalis* occurs only in the Central and Pacific regions, and *E. s. dorsalis*, the only other form with red interspaces, he limits also to the Central region. We have, however, a very common form in central and western Indiana, which Dr. Hay, in his "Batrachians and Reptiles of Indiana," and I in my former paper both called *E. s. parietalis*. It has numerous brick-red spots intermingled with blackish ones on the anterior third of body. It possesses the power of flattening the body more than any of the other forms, and when so flattened shows numerous small bluish white spots between the black and red ones. The gastrostegees have a black dot on each margin. It ranks next to *E. s. sirtalis* in abundance, and reaches a length of three feet.

On March 29, 1894, I observed a sparrow-hawk fly across a meadow bearing a wriggling snake in its talons. I slipped up beneath the thorn tree in which it alighted and giving a sudden whoop caused it to drop its prey, which proved to be an example of *E. s. parietalis*, as above limited. The varieties of *E. sirtalis* occurring in Indiana are so numerous and grade so insensibly into one another, that it is better, in my opinion, to regard them all as mere forms of the one species than to attempt to give a trinomial cognomen to each individual happened upon.

NATRIX FASCIATA SIPEDON (Linn.). Spotted Water Snake.

This, the *Tropidonotus sipedon* of my former paper, when disturbed, often flattens the head and anterior third of the body, even to a greater extent than *H. platyrhinos*. At the same time it exudes its disgusting odor, and then begins to strike vigorously at the intruder.

***NATRIX RHOMBIFERA (Hallow.).** Diamond Water Snake.

This species occurs in the large ponds of the annually overflowed bottom lands of southern Vigo County. It may be known by its 27 rows of strongly keeled scales, and by the squarish brown spots on the back alternating with those on the sides and connecting with them at the angles. A specimen in the State Museum was labeled "Copperhead—A Poisonous American Serpent—*Trigonocephalus contortrix*—called also copper-bell and red viper, from Morgan County, Indiana." • A second specimen was labeled "*Heterodon platyrhinos*, Clay County, Indiana." It is four feet

two inches in length, five inches in circumference, has 143 gastrosteges, 65 urosteges, three postorbitals, 27 rows of strongly keeled scales and 31 lateral blotches before the anus.

Cope says of this species: "It remains within the boundaries of the Austroriparian district, not extending north of southern Illinois and Indiana." Hay, however, records it from Lafayette, Wheatland and New Harmony, Indiana.

STORERIA OCCIPITOMACULATA (Storer). Red-bellied Snake. Storer's Brown Snake.

But two additional specimens of this scarce reptile have been seen since my former paper was printed. One was taken from beneath a log in damp upland woods, on October 14. A week later, while driving in the northern part of the county, I saw a chicken running along the roadside with a squirming snake in its bill. After a sharp chase of the fowl through a rail fence and a blackberry patch, its prey was dropped and proved to be a fine specimen of Storer's snake. As soon as it found itself free it wrapped its tail about a small bush and, when approached, flattened itself very much after the manner of a spreading viper. The row of brown dots bordering the pale band along the back then became much more prominent than they are when the body is in its normal shape.

LACERTILIA.

SCINCIDÆ.

EUMECES FASCIATUS (Linn.). Red-headed Lizard. Blue-tailed Skink.

June 11, 1894, one of my pupils, Harley McIlroy, of Macksville, found two of these lizards in a crow's nest in the top of a beech tree. The male escaped. The female, 10½ inches in length and heavy with eggs, was captured, but unfortunately was immediately killed. The eggs were almost ready for extrusion, and dissection showed them to be 18 in number. They were circular in outline, 11 mm. in diameter and the outer integument was of a leathery consistency.

The only record of its reproductive habits which I can find is by Smith, who states that "it lays nine oval eggs at a time."*

This species, which is blue-tailed when young and red-headed when old, is much more common in the southern than in the central and northern part of the State. Two specimens which were taken near Wyandotte Cave, May 11, 1897, were respectively 12 and 13 inches in length. One of them bit me in the index finger, but the bite was not as painful as that of a mouse.

*Geol. Surv. of Ohio, IV, 1882, 651.

TESTUDINATA.

KINOSTERNIDÆ.

**KINOSTERNON PENNSYLVANICUM* (Bosc.). Mud Turtle.

A male of this species, five and one-half inches in length, was taken from the margin of a large pond in the southern part of the county on June 18, 1892. It has been recorded in Indiana only from Knox County, where, according to Ridgeway, it is common about Monteur's Pond.

EMYDIDÆ.

**PSEUDEMYIS ELEGANS* (Wied.). Elegant Terrapin.

One small and one large specimen of this turtle were found dead by the margin of a large pond five miles north of Terre Haute, on July 6, 1892. No living specimens have been seen, and hence nothing distinctive of its habits can be recorded. It is said by Hay to be frequent in Posey County, and a single specimen was taken by him near Winamac in the northwestern part of the State.

CISTUDO CAROLINA (Linn.). Box Turtle.

This continues to be quite a common species, especially in sandy woodlands, and many very old specimens, judging from their appearance, have been noted. The smallest one yet seen was taken in September, 1891, and measured but two inches across. I have twice surprised adults feeding upon ripe papaws. In one instance more than two-thirds of a large-sized one had been devoured.

* * *

The following is a list of all species of *Batrachia* and *Reptilia* taken in Vigo County. Examples of all are now in my private collection. Those recorded in my former paper are followed by parenthesis enclosing the letter I and number of page in Vol. XIV of the Journal of the Cincinnati Society of Natural History in which mention of them was made.

BATRACHIA.

1. *Necturus maculatus* Raf. Water Dog. Mud Puppy. (I. p. 23).
2. *Amblystoma opacum* (Gravenh.). Marbled Salamander. (I. p. 24, 35).
3. *Amblystoma punctatum* (Linn.). Spotted Salamander. (I. p. 24).
4. *Amblystoma tigrinum* (Green). Tiger Salamander. (I. p. 24).
5. *Amblystoma jeffersonianum jeffersonianum* (Green). Jefferson's Salamander. (I. p. 24).

6. *Chondrotus microstomus* (Cope). Small-mouthed Salamander. (I. p. 24).
7. *Hemidactylium scutatum* Tschudi. Scaly Salamander. (I. p. 25).
8. *Plethodon cinereus* (Green). Ashy Salamander. Red-backed Salamander. (I. p. 25).
- 8a. *Plethodon cinereus erythronotus* (Green). Red-backed Salamander. (I. p. 25).
9. *Plethodon glutinosus* (Green). Slimy Salamander. (I. p. 25).
10. *Spelerpes bilineatus* (Green). Two-lined Triton. (I. p. 25).
11. *Spelerpes longicaudus* (Green). Long-tailed Triton.
12. *Diemyctylus viridescens* Raf. Green Triton. Newt. (I. p. 26).
13. *Siren lacertina* Linn. Siren. Mud Eel. (I. p. 26).
14. *Bufo lentiginosus americanus* Le Conte. American Toad. (I. p. 27).
15. *Acris gryllus gryllus* (Le Conte). Cricket Frog.
- 15a. *Acris gryllus crepitans* Baird. Cricket Frog. Peeper. (I. p. 27).
16. *Chorophilus triseriatus* (Wied.). Swamp Tree Frog. (I. p. 27).
17. *Hyla pickeringii* (Storer). Pickering's Tree Frog. (I. p. 27).
18. *Hyla versicolor* Le Conte. Common Tree Frog. (I. p. 28).
19. *Rana virescens virescens* Kalm. Leopard Frog. (I. p. 28).
20. *Rana palustris* Le Conte. Pickerel Frog. Swamp Frog. (I. p. 28).
21. *Rana areolata circulosa* Rice and Davis. Hoosier Frog. Ring Frog.
22. *Rana clamata* Daudin. Green Frog. Spring Frog. (I. p. 28).
23. *Rana catesbiana* Shaw. Bull Frog. (I. p. 28).
24. *Rana sylvatica* Le Conte. Wood Frog. (I. p. 28).

REPTILIA.

1. *Carphophiops amœnus* (Say). Worm Snake. Ground Snake. (I. p. 35, Var. *helenæ*).
2. *Ophibolus doliatus* (Linn.). Red Snake. Corn Snake. (I. p. 32).
- 2a. *Ophibolus doliatus triangulus* (Boie). House Snake. Milk Snake. (I. p. 32).
- 2b. *Ophibolus doliatus collaris* Cope.
3. *Ophibolus getulus sayi* (Holbrook). King Snake. (I. p. 32).
4. *Ophibolus calligaster* (Say). Chain Snake.
5. *Diadophis punctatus* (Linn.). Ring-necked Snake. (I. p. 32).
6. *Cyclophis æstivus* (Linn.). Summer Green Snake. (I. p. 31).
7. *Bascanion constrictor* (Linn.). Black Snake. Blue Racer. (I. p. 31).
8. *Coluber obsoletus* Say. Pilot Snake. Black Racer. (I. p. 31).
9. *Heterodon platyrhinos* Latreille. Spreading Adder. Blowing Viper. (I. p. 32).
10. *Eutemia saurita* (Linn.). Ribbon Snake. (I. p. 29).
11. *Eutemia proxima* (Say). Say's Garter Snake.

12. *Eutania nivalis* (Linn.). Garter Snake. (I. p. 30).
13. *Natrix leberis* (Linn.). Queen Snake. Leather Snake. (I. p. 30).
14. *Natrix fasciata sipodon* (Linn.). Spotted Water Snake. (I. p. 30).
15. *Natrix rhombifera* (Hallow.). Diamond Water Snake.
16. *Clonophis kirtlandi* (Kenn.). Kirtland's Snake. (I. p. 29).
17. *Storeria occipitomaculata* (Storer). Red-bellied Snake. Storer's Brown Snake. (I. p. 29).
18. *Storeria dekayi* Holbrook. DeKay's Brown Snake. (I. p. 29).
19. *Eumeces fasciatus* (Linn.). Red-headed Lizard. Blue-tailed Skink. (I. p. 33).
20. *Amyda mutica* (Le Sueur). Leather Turtle. (I. p. 33).
21. *Aspionectes spinifer* (Le Sueur). Common Soft-shelled Turtle. (I. p. 34).
22. *Chelydra serpentina* (L.). Common Snapping Turtle. (I. p. 34).
23. *Kinosternon pennsylvanicum* (Bosc.). Mud Turtle.
24. *Malaclemmys geographicus* (Le Sueur). Map Turtle. (I. p. 34).
25. *Malaclemmys lesueuri* (Gray). Le Sueur's Map Turtle. (I. p. 34).
26. *Pseudemys elegans* (Wied.). Elegant Terrapin.
27. *Chrysemys marginata* (Agassiz). Painted Turtle. (I. p. 34).
28. *Cistudo carolina* (Linn.). Box Turtle. (I. p. 35).

A CATALOGUE
OF THE
FLOWERING PLANTS
AND OF THE
FERNS AND THEIR ALLIES
INDIGENOUS TO INDIANA.

BY STANLEY COULTER.

INTRODUCTION.

Many local lists, and at least one State list, represent the work done upon the flora of Indiana in the past. The work has in the main been of excellent character and has served the purpose of furnishing to botanists a fairly complete knowledge of the constituent members of the State flora. The lists have, however, been mere lists, and no attempt has been made to use the data thus obtained in any interpretative way. As a consequence they have been of no value to the general public, nor have they in any way been serviceable to that class of our population, the agriculturists, to whom a knowledge of the plant life of the State is of the greatest significance. This statement is not made in the spirit of criticism, but as furnishing a reason for the preparation of the present list of the native plants of the State, in which an attempt is made to so use the data, as to give to the plants their real significance in the interpreting of soil, moisture and temperature conditions.

It is believed that the message of the plants may be easily read by those destitute of scientific training, if they but use their eyes, and because of this belief, there has been a constant attempt to avoid technical language and to discuss the significance of our common plants in a way readily understood.

Evidently a knowledge of the boundaries and general topography of the area considered, is essential if we would thoroughly understand the plant life of the State. The data for this part of the report are drawn from Dr. Chas. R. Dryer's "Indiana Geography," due credit being given for the extracts made.

Since all our soils, with the exception of humus, are derived from the degradation of rocks, a discussion of the geology of the State in its relation to soils has been necessary, the materials for this part of the paper being drawn from various papers of State Geologist Blatchley. Based upon this, an attempt is made to group plants characteristic of certain types of soil in such a way, that whenever a particular assemblage of plants is seen the soil character may be inferred.

But that the story of the plants may be intelligently read, there must be a fundamental understanding of the chief factors which modify plant life and govern plant distribution. A brief discussion of these factors serves to divide the State into certain areas of fairly

definite limits, each of which possesses its characteristic flora. The character plants of these regions being given and their general appearance and habit being understood, the interpretation of soil conditions in new areas, is a relatively easy matter. It can be taken as an axiom, that the native plants of a region are the best index of its agricultural capacities, a statement which at once indicates the practical value of this knowledge of type plants. This knowledge is not dependent upon ability to use a "key" or remember a scientific name, it depends simply upon keen vision and a quick perception of relations. These lists of type plants are therefore of especial significance, and they have been collated with great care.

Plants have also a direct bearing upon man, some being of high value to him, some impeding his efforts, some being positively injurious. The report therefore discusses these plant relations with considerable fullness. Thus the timbers of the State are considered not merely in relation to their distribution, but also as regards their uses. Some suggestions are also offered concerning the reclaiming of waste areas, the selection of forms suitable for such work and methods of planting. The weeds and poisonous plants are also considered, not only as regards their noxious qualities, but also as to their general appearance and habits of growth, in order that they may be easily recognized.

The general conclusions with the antecedent discussions are best treated in paragraph form, and hence precede the catalogue. Under each specific form listed in the latter, there is given its known distribution within the State, together with other data of interest and value. This catalogue represents the results of twenty years' study of the flora of the State, the collection of the data for its presentation in the present form having been carried on for the past six years. It is presented in the hope that it will serve to show the intimate relations existing between science and the various industries dependent upon cultivation of the soil.

BOUNDARY.

"The State of Indiana is included between $37^{\circ} 41'$ and $41^{\circ} 46'$ north latitude, and between $84^{\circ} 44'$ and $88^{\circ} 6'$ west longitude. It is bounded on the north by the parallel which is ten miles north of the southern extremity of Lake Michigan; on the east by the meridian of the mouth of the Great Miami River; on the south by the Ohio, and on the west by the Wabash River and the meridian of Vincennes. Its extreme length is 250 miles, its average width 145 miles, its area, 36,350 square miles."

ELEVATION.

"The highest land in the State, in southern Randolph County, is 1,285 feet above tide; the lowest, at the southwestern corner, is 313 feet. The area above 1,000 feet comprises 2,850 square miles in three tracts: (1) An irregular area around the headwaters of the White Water River in Union, Wayne, Randolph, Delaware, Henry, Rush, Decatur, Franklin and Ripley counties. (2) A narrow crescentic ridge in Brown County. (3) A considerable area in Steuben, Dekalb, Noble and Lagrange counties. Isolated peaks rise in Brown County to 1,172 feet, and in Steuben to 1,200 feet. The area between 500 and 1,000 feet in elevation is 28,800 square miles, and that below 500 feet is 4,700 square miles. The average elevation of the State is 700 feet."

DRAINAGE.

"The general slope of Indiana is to the southwest as indicated by the course of the Wabash River and its tributaries, which drain two-thirds of the State. Of the remaining third, one-half is drained directly to the Ohio, and one-half to Lakes Erie and Michigan, and to the Mississippi through the Illinois."

PHYSIOGRAPHIC FEATURES.

The greater part of Indiana is a *plain of accumulation*; the surface of a sheet of glacial drift, which varies in thickness from a few feet to 500 or more. The average thickness is more than 100 feet. It consists chiefly of a mass of clay containing more or less gravel and boulders. This is locally varied by heaps, ridges, sheets and pockets of sand and gravel, and in the southern part of the State is overlain by a peculiar fine silt, called *loess*.

The driftless area is a *plain of degradation*, formed by the removal of the original rock surface to an unknown depth, and now represented by the summits of flat and even topped divides, ridges and hills.

On the plain occur numerous *hills of accumulation* forming the great morainic belts, the result of excessive dumping and heaping up of drift along the margins and between the lobes of the melting ice-sheet. The most impressive examples are found in Steuben, Lagrange, Noble and Kosciusko counties, where they attain a height of 200 feet or more, and are as steep and sharp as the materials will lie. The Ohio slope is studded all over with *hills of degradation*, blocks and fragments of the original plain left by the cutting out of the valleys between them. These are very conspicuous in the counties of Greene, Daviess, Martin,

Crawford, Orange, Washington and Jackson, but attain their greatest development in Floyd, Clark and Scott, where the Silver Hills and Guinea Hills rise to 400 and 500 feet above the valley bottoms. In Brown County the knob topography attains the highest absolute elevation in Weed Patch Hill, and the surrounding region is so rugged as to have gained the title of the "Switzerland of Indiana."

In addition to the massive and rugged moraine belts already described, there are many morainic ridges of gentle slope and smooth profile, conspicuous only upon the map by their influence upon streams. Those which extend along the right bank of the St. Mary's, upper Wabash, Salamonie, Mississenewa and upper White rivers are typical examples. In this connection should be mentioned the form of moraine known as *boulder belts*—long, narrow, curving strips of country, thickly covered with large boulders. These occur in many counties in the northern half of the State.

Dunes and Beach ridges are hills and ridges of sand or gravel, either blown up by the wind or built up by the waves of lakes now withdrawn. Such features are found in the region around the head of Lake Michigan, the Kankakee basin, and the Maumee Lake basin, east of Fort Wayne.

All the *valleys* of Indiana are the result of stream erosion; most of them by the streams which now occupy them. During the glacial period, however, the streams generally carried much more water than at present.

Gorges and ravines exist in great number and variety throughout the Ohio slope, occurring along the White Water, White and Ohio rivers, and all their tributaries. The eastern tributaries of the Wabash in Fountain and Parke counties flow through very beautiful canyons, cut in massive sandstone. In valleys of this character rapids and falls are very numerous. They occur upon nearly every stream emptying into the Ohio, and vary in height from a few feet to sixty or eighty.

Between the terraces of sand and gravel, which border the present channels of our streams, and mark the heights at which they were once able to deposit sediment, there are often broad "bottoms" or *flood plains*, which furnish the best corn lands in the world.

The surface of the northern plain is thickly sprinkled with small lakes, which occupy irregular depressions in the surface of the drift and are especially characteristic of the massive moraines. The whole number can not be less than 1,000. The largest, Turkey Lake, in Kosciusko County, has an area of five and a half square miles.

The *marshes* and *swamps* exceed the lakes in number and extent.

The smaller ones are the basins of former lakes, which have been filled with sediment and vegetation. The largest are in the Kankakee basin, and are the remaining vestiges of a glacial lake. Everywhere over the central plain the divides are too flat and the slopes too gentle for good drainage, and marshes abound. These, however, have been largely drained by ditches.

The above physiographic features are selected from the very complete presentation of the subject by Dr. Dryer in his General Geography of Indiana, as being those bearing most directly upon the distribution of the flora of the State. Those parts presented have at times been abridged, the omitted parts, being as a rule, illustrations of the special feature discussed.

CLIMATE.

Taking the record for 1896, which was very nearly a normal year, the following summarizes the results drawn from observations upon rainfall and temperature.

"The mean temperature for January varied from 25° in the north to 33° in the south, for July from 72° to 77°. The absolute extremes of temperature for the State and year were 103° and —22°.

"The number of days in the year with average temperature below freezing was ninety in the north and twenty in the south. The changes of temperature are frequent, except in summer, when a period of two or three months of uniformly warm, clear weather often occurs.

"The mean rainfall is quite variable from year to year, ranges from thirty-five inches in the north to forty-five inches in the south, and is well distributed throughout the year, with a slight excess in spring. The prevailing winds are from the southwest and the average wind velocity, seven to nine miles per hour."

The following tables taken from an article by Prof. H. A. Huston in Indiana Agricultural Reports, Vol. 40, p. 503, 1898, will perhaps serve to give a clearer idea of the climatal conditions of the State:

AVERAGE TEMPERATURE FOR FOURTEEN YEARS—DEGREES FAHRENHEIT.

AVERAGE.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Northern	23.4	26.8	35.1	53.3	60.2	70.7	74.0	70.9	64.8	51.0	38.6	30.9
Central	26.4	30.2	37.9	52.3	61.7	72.0	74.8	71.6	66.1	52.3	40.4	33.1
Southern	30.2	33.9	41.4	55.8	63.8	73.6	75.8	74.4	67.8	54.7	43.5	35.8

AVERAGE PRECIPITATION IN INCHES.—FOURTEEN YEARS.

AVERAGE.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Northern.....	2.49	2.57	2.52	3.08	4.47	3.81	3.07	2.82	3.11	1.86	3.46	2.52
Central	2.99	3.09	2.93	3.54	3.98	3.92	3.11	3.24	3.21	1.80	4.01	2.78
Southern.....	3.64	4.06	3.95	4.01	3.96	4.20	3.55	3.45	3.20	2.02	4.47	3.08

SOILS.

“The soils of Indiana may be roughly classified into three great groups; viz., drift soil, residual soils and alluvial soils. The drift soils are found in the northern three-fourths of the State, are extremely varied in depth and character and are formed of a mass of heterogeneous material which was brought to its present resting place by a great glacier or slowly moving sheet of ice, which thousands of years ago, covered the area mentioned.

“The residual soils are found in the counties south of the southern limit of the glacier. They were formed, for the most part, in the place where they are now found, by the decay of the underlying limestone or sandstone rocks. The variety of materials entering into their composition is therefore limited, and they are, for that reason, among the poorer soils of the State.

“The alluvial soils are those of the river and creek bottoms throughout the State. Gentle rains and earth-born torrents, little trickling rills and strong streams are ever at work tearing down the soils and underlying clays from every slope, and bearing them away to lower levels. The small water-formed trench of to-day next year becomes a chasm and ages hence a hollow, and the transported material is gradually deposited as alluvial soil over the so-called “bottom lands,” which are annually overflowed.

“The drift soils which cover the northern and central portions of Indiana, derived, as they were, from various primary and igneous rocks in the far north—ground fine and thoroughly mixed as they were by the onward moving force of a mighty glacier—are usually rich in all the necessary constituents of plant food. Neither they nor the alluvial soils require a large annual outlay for fertilizers as do the residual soils of southern Indiana, over which the drift of the glacial period did not extend.”*

* Blatchley—21st Ann. Rep. Dep. of Geol. and Nat. Resour. of Indiana, 1896, pp. 21-22.

PLANT SOCIETIES.

Plants are living things, and their occurrence and persistence in any given region is not a matter of chance, but is determined by surrounding conditions. There is a constant struggle in nature among plants, not merely to fill unoccupied territory, but also to maintain positions already held. Because of this, plants having similar vital necessities are found associated, forming plant societies or unions, and these plant societies stand as the sign of the capacity of that particular region, in the sustaining of plant life. Plant societies are usually made up of many different kinds of plants, since, if those of the same form or of closely related forms were thus associated, the vital necessities would be absolutely identical, and the struggle for existence would become too intense. An ability to determine the significance of these plant societies, to interpret the factors which make them possible, would serve to save much costly experimentation and to prevent many serious failures. No surer sign can be found of the agricultural capacity of a soil than is furnished by the native plants there growing. But the sign to have significance must be interpreted.

The chief factors controlling plant distribution are *light, heat, water, soil*, both as regards its chemical composition and physical character, and *wind*.

Light, because many of the most important functions of the plant, such as transpiration and carbon fixation, are largely or wholly dependent upon its presence.

Heat, because plants have certain temperature requirements. These requirements differ in a considerable degree in different species, but, as a rule, plants work only at a temperature between 32° to 122° Fahr.

Water, since all soil derived foods must be taken in the form of a watery solution, and its presence in a certain amount is imperative. In this, also, there exists a wide range, as is shown by the fact that some plants live totally submerged in water, while others are able to endure long continued drought.

Soil, for the reason that its chemical composition determines the food materials carried by the water, while its physical character determines both its ability to receive and retain moisture. Sand and clay illustrate reverse conditions in the matter of the reception and retention of water.

Winds, where strong and long continued, because of their drying effect upon the atmosphere and the consequent abstraction of water from the plant by the thirsty air. In our own State this factor is, perhaps, less apparent in its influence than the others, although, in certain

regions near Lake Michigan, it has had a very marked effect in determining the existing flora.

It is the influence of these factors, operating in differing localities in varying intensity and proportion, that determines plant distribution. As conditions change, the plants must either change to meet these new conditions or perish. Various adaptations, in familiar forms, show how plastic is the plant and how quickly it responds to new conditions. The hackberry (*Celtis occidentalis*), which is a tall tree on bottom lands, becomes a thorny shrub on dry sand dunes, and the ordinary wild rose, which in swamps or upon a lake margin, is from six to ten feet high and almost thornless, dwindles to a stunted bush from twelve to eighteen inches high, and is absolutely covered with thorns when it grows upon a dry sand ridge. Marked changes also show themselves in the size and structure of the leaf.

It is probable that water, in the long run, more than any other of the factors just named, influences plant distribution, although it must be remembered that no one factor alone determines a plant society. So important is this water factor that the grouping of plants is generally based upon it, the subordinate groupings showing the relation of the plants to the other factors. Upon this basis three great groups of plants can be recognized in Indiana.

I. Water-loving plants (*Hydrophytes*) adapted for living either wholly submerged in the water or in soil exceedingly rich in water. Evidently such conditions are to be found in the shallower water of lakes, in swamp regions and along the lower stretches of our streams. The plants growing in this extreme condition are characteristic and easily recognized. The "cat-tail," the various "rushes," tall, rank "sedges," "wild flags" and many other familiar forms will be at once recalled as of this type.

II. Dry soil plants (*Xerophytes*), which stand at the opposite extreme of the water condition, successfully maintaining life in localities where both soil and air are extremely dry. It is apparent upon the most cursory thought, that plants under these conditions must differ greatly in general appearance from the water-loving plants. To meet their drought conditions, many adaptations have been developed, both for the prevention of the loss of moisture from the plant and for storing away for future use the scant excess of water that may from time to time be secured. Regions furnishing these conditions are not abundant in Indiana, although in the "dune" regions along the southern shore of Lake Michigan and on occasional sand ridges, left by the glaciers, such desert plants may be found. Bug seed (*Cakile edentula*),

sea-rocket (*Corispermum hyssopifolium*) and prickly pear (*Opuntia humifusa*) suggest themselves as familiar examples of this type of plant. Still more do the stunted forms, the reduced leaves and the surface hairs or epidermal thickenings of most plants in such regions tell the story of the arid soil.

III. Intermediate plants (*Mesophytes*) or those adapted to intermediate conditions of both soil and air moisture. Such plants include the great majority of our forms, since these conditions prevail throughout the entire State. The plants of use to man, as well as the weeds, belong to this group, since plants to be either of high economic value or serious injury to man must be such as are adapted to these medium, or average conditions. Mesophyte conditions are, indeed, agricultural conditions. If a farmer has a swamp tract (*hydrophyte conditions*) which he desires to cultivate, he drains it, that is he strives to bring it to mesophyte conditions. If it is wished to redeem an arid region (*xerophyte condition*) irrigation is employed that the mesophytic condition may be reached. This mesophytic or intermediate flora stands therefore as the index of the agricultural fitness of the land so far, at least, as the water content of the soil is concerned.

Sub-divisions under each of these great groupings, based upon other factors influencing the distribution of plants, can be made, showing how perfectly the indigenous flora of a region stands as the sign of its agricultural capacity. While all plants tell the story, none tell it so plainly as the trees, which represent the ultimate possibility in a vegetative way, of soil and sun and air and centuries of time. It is impossible, with the data at hand, to more than indicate some of the more important of these sub-divisions, such as "clay-soil societies," "limestone soil societies," "sand plants," "cliff plants" and "swamp plant" societies. It must be remembered, however, that no one plant standing alone is characteristic of any given set of conditions, although a group of a half dozen or more species can usually be selected which will, as a rule, not be found associated under any other set of conditions. It is the ability to distinguish these characteristic groupings, which enables us to read the message of the plants.

It will be seen from the above, that it is quite possible to construct a map of the State showing the distribution of these three great groups with a fair degree of precision. Such a map would be a phytogeographic map. In the past four years there is a growing inclination to call the study of plant distribution, *phytogeography*.

The large Hydrophyte areas would be found in the great Kankakee marshes, about the innumerable small lakes of northern Indiana, in

the swamps covering thousands of acres that hang heavily along the banks of the Wabash in its lower stretches and isolated patches at every pond and lakelet or wherever there exists a sluggish, low-banked stream. The continuous areas are those in the Kankakee region in the northwest, and the cypress swamps in the extreme southwestern counties. In these regions water-loving plants dominate vegetation and give their peculiar cast to landscape features.

The dry plant, or Xerophyte, regions are found chiefly in the northern parts of the State. The only continuous area is a relatively narrow fringe along the shores of Lake Michigan, where desert plants and those showing alpine or arctic characters, struggle as best they may for a precarious livelihood along the beaches, or gain a firmer footing upon some captured dune somewhat further back from the shores. Isolated areas are also found, chiefly in the northern portions of the State, where bare sand ridges or "barrens," dating back to glacial times, furnish somewhat similar conditions. In other parts of the State an occasional ancient river beach or bar may give a sharply limited home for plants of this type.

The remainder of the State, constituting by far its larger part, furnishes the intermediate plant or mesophytic area. Wherever these regions meet there is an overlapping of forms. Intermediate plants developing adaptations for increased moisture conditions invade the territory of the water-loving plants, and the hydrophytes retaliate by an invasion of the intermediate area.

Where drainage upon a large scale has been introduced, sharp changes in the water content of the soil and in the soil water level have of course resulted. In such regions equally sharp changes must have occurred in the flora. Existing forms have either taken on adaptations for the new conditions or must have given way to other forms. How great these changes are at times has been shown by W. W. Chipman¹ in his studies of the successive floras inhabiting a definite area. In this case no less than three floras of distinct type followed each other within a period of six or eight years. These changes of the soil water level do not merely affect herbaceous forms of annual or biennial habit. At times they affect forest trees, a fact shown by the death of beech trees, which followed extensive drainage operations in various counties of the State. The root habit of the beech furnishes the reason for its more ready yielding to changed water conditions. Considerable forest areas, however, of mixed forms have shown a decided depreciation in value in regions where drainage operations have been extensive.

¹Proc. Ind. Acad. Sci., 1896, pp. 147-158.

It is in these areas of overlap and changing conditions that those variations from "the description" are constantly occurring, which are responsible for so many errors of reference in plant lists. The plasticity of the plant and the potency of environmental factors have been too often lost sight of by the systematist.

HYDROPHYTES.

The following plants may be taken as the most prominent forms of this type. The distribution of the species will be found in the general catalogue:

- Typha latifolia* L. Cat-tail.
Potamogeton pulcher Tuckerm. Pondweed.
Potamogeton prolongus Wulf. Pondweed.
Potamogeton zosterifolius Schum. Pondweed.
Potamogeton foliosus Raf. (= *P. pauciflorus* Pursh.).
Potamogeton diversifolius Raf. (= *P. hybridus* Michx.).
Potamogeton Spirillus Tuckerm.
Potamogeton Robbinsii Oakes.
Zannichellia palustris L. Horned Pondweed.
Sagittaria latifolia Willd. (= *S. variabilis* Engl.). Arrowhead.
Philotria Canadensis (Michx.) Britt. (= *Elodea Canadensis* Michx.).
 Waterweed.
Vallisneria spiralis L. Tape-grass. Eel-grass.
Alisma Plantago-aquatica L. (= *A. Plantago* L.). Water Plantain.
Eriocaulon septangulare Withering. Pipewort.
Wolffia Columbiana Karsten.
Spirodela polyrhiza Schleid.
Lemna trilinea L. Duckweed.
Lemna minor L.
Peltandra Virginica (L.) Kunth. Arrow Arum.
Pontederia cordata L. Pickerel-weed.
Heteranthera reniformis Ruiz. and Pav. Mud-plantain.
Heteranthera dubia (Jacq.) McM. (= *H. graminea* Vahl).
Iris versicolor L. Larger Blue Flag.
Polygonum Hartwrightii Gray. Knotweed. Red-flowered Smartweed.
Polygonum hydropiperoides Michx.
Polygonum amphibium L. Water Smartweed.
Ceratophyllum demersum L. Hornwort.
Cabomba Caroliniana Gray.
Brasenia purpurea (Michx.) Casp. (= *B. peltata* Pursh.). Watershield.
Nymphaea advena Soland (= *Nuphar advena* Ait.). Yellow Pond Lily.
 Splatter Dock.

- Castalia odorata* (Dryand) Woodv. and Wood (= *Nymphaea odorata* Ait.).
Sweet-scented Water Lily.
- Castalia tuberosa* (Paine) Greene (= *Nymphaea reniformis* D. C.). Tuber-
bearing Water Lily.
- Nelumbo lutea* (Willd.) Pers. Yellow Nelumbo, or Water-chinquapin.
- Sarracenia purpurea* L. Pitcher-plant. Side-saddle Flower.
- Ranunculus Purshii* Richards (= *R. multifidus* Pursh.). Yellow Water
Crow-foot.
- Batrachium trichophyllum* (Chaix.) Bossch. (= *Ranunculus aquatilis tricho-*
phyllum Gray). Common White Water Crow-foot.
- Roripa palustris* (L.) Bess. (= *Nasturtium palustre* D. C.) Marsh Cress.
- Roripa Nasturtium* (L.) Rusby. (= *Nasturtium officinale* R. Br.) True
Water Cress.
- Roripa Americana* (Gray) Britton (= *Nasturtium lacustre* Gray). Lake
Cress.
- Callitriche heterophylla* Pursh. Water Starwort.
- Isnardia palustris* L. (= *Ludwigia palustris* Ell.) Water Purslane.
- Hippuris vulgaris* L. Mare's Tail.
- Myriophyllum spicatum* L. Water-milfoil.
- Myriophyllum verticillatum* L.
- Myriophyllum heterophyllum* Michx.
- Myriophyllum pinnatum* (Walt) B. S. P. (= *M. scabratum* Michx.)
- Myriophyllum humile* (Raf.) Morong. (= *M. ambiguum* Nutt.)
- Sium cicutæfolium* Gmelin. Water Parsnip.
- Hottonia inflata* Ell. Featherfoil. Water Violet.
- Utricularia vulgaris* L. Bladderwort.
- Utricularia purpurea* Walt.
- Utricularia gibba* L.
- Dianthera Americana* L. Water-willow.
- Bidens Beckii* Torr. Water Marigold.

To this list there would properly be added the numerous forms of rushes (*Juncaceæ*), sedges (*Cyperaceæ*) and grasses (*Gramineæ*), which are omitted because the species are unfamiliar and in many cases of difficult discrimination. Many forms, which are more strictly marsh plants, might also have been listed at this place. These marsh plants stand for a soil very rich in water and are true hydrophytes.

THE XEROPHYTE FLORA.

The researches of Dr. H. C. Cowles, of Chicago University, upon the Dune Floras of Lake Michigan, have made it possible to present in considerable detail various plant unions of this type. From the mono-

graph of Dr. Cowles¹ and through additional suggestions furnished by him, the materials for this section have been derived. So complete and satisfactory was the study of Dr. Cowles, that previously prepared discussions of this flora have been discarded and his article taken as the basis of the presentation of the subject.

From the ecologic sub-divisions worked out by Dr. Cowles, the following have been selected as fairly representing characteristic conditions in the area considered.

I. THE LOWER BEACH.

“The lower beach has been defined as the zone of land washed by the waves of summer storms. It might also be defined as that portion of the beach which is devoid of vegetation. Perhaps there is no flora in the temperate zone quite so sparse as that of the lower beach, unless we except bare rocks and alkaline deserts. Land life is excluded because of the frequency and violence of storms; the waves tear away the sand in one spot only to deposit it in another. Even though a seed had the temerity to germinate, the young plant would soon be destroyed by the breakers. Water life is excluded because of the extreme Xerophytic conditions, which commonly prevail on the lower beach. Thus the lower beach is a barren zone between two zones of life. Below it there exist algæ and other hydrophytic forms, which flourish in the fury of the breakers; above it there exists the flora of the middle beach, a flora adapted to the most intense xerophytic conditions. At no particular time, perhaps, are the conditions too severe for some type of life; vegetation is excluded because of the alternation of opposite extremes.”

II. THE MIDDLE BEACH.

“This is situated between the upper limits of the summer and winter waves, comparatively dry in summer, but washed by high waves in winter. It may also be defined as the zone of *succulent annuals*. The life conditions of this zone are exceedingly severe and result in a flora of the most pronounced xerophytic characters.” The winter storms preclude the possibility of survival through that period, thus practically excluding biennials and perennials. “In the summer time the xerophilous conditions are extreme. Nowhere in the dune regions are the winds more severe than here. No flora is more exposed to the extreme desiccating influences of the summer sun than that which grows upon the bare and open beach.”

¹Cowles, H. C.—“*The Ecological Relations of the Vegetation of the Sand Dunes of Lake Michigan.*” Bot. Gaz., Vol. 27, Nos. 2, 3, 4 and 5.

III. THE UPPER BEACH.

This is the part of the beach beyond the reach of the waves. "The life conditions are much less severe than on the middle beach, chiefly because of the freedom from the wave action of the winter storms. The exposure to the sun is almost as great as on the lower zones, but there is more protection from the wind because of the abundance of driftwood. The decay of the driftwood may also add no inconsiderable portion to the food material of the beach plants.

"The flora of the upper beach is much richer than that of the middle beach, both in species and individuals, but here as there the vegetation is so sparse that the tone to the landscape is given by the soil."

IV. THE ACTIVE DUNES.

Neglecting some very interesting phases in the life history of dunes, touching upon their embryonic stages and the plants concerned in fixing them and passing also their transformation into wandering dunes, we may consider the conditions in this active dune which is usually a part of what Dr. Cowles denominates the *dune complex*. The factors involved give, of course, to the complex great instability, but it is very evident that in this shifting maze plant life must be very scant. "The reasons for the scanty plant life on the exposed portions of the dune complex are not far to seek. First of all it is *not* due to the scarcity of water in the soil. Even after a long period of drought in summer, the sand is cool and moist at a short distance below the surface. In spite of the water supply in the dune sand, the scanty flora of the complex is characterized by the possession of the most pronounced xerophytic adaptations to be found in this latitude. In the main these adaptations are to guard against excessive transpiration, such as is induced by unusual exposure to wind, heat and cold.

"Directly or indirectly, the wind is the factor primarily responsible for the scant vegetation of the dune complex." While incidentally the wind dries up the soil and increases transpiration, and while its mechanical action in connection with the sand blast is destructive to vegetation, its cardinal destructive influence lies in its power to cover and uncover the dune plants.

V. THE ESTABLISHED DUNES.

In time the slowly advancing slopes of the dune complex may be captured by vegetation and be transformed into an established dune. The story of the capture is wonderfully interesting, when followed in its details. Briefly stated the stages are something like this. First,

social perennial herbs such as *Ammophila* and *Asclepias* obtain a foothold, these are followed by shrubs like *Cornus*, *Salix* and *Prunus*, which gradually drive out the former plants, which are not adapted to the shade. The shrubs are followed or accompanied by tree-forms, especially in our area, by the basswood *Tilia Americana*, with the appearance of the trees, vegetation becomes more and more abundant, and the plant forms become of a more decided mesophytic cast. It is impossible in this connection to do more than to select a few types of established dunes, which may be taken to be fairly representative of our lake shore regions. The three selected are the Basswood, Evergreen and Oak dunes. The obvious condition which favors the rich development of plants is the almost complete protection from the wind.

PLANTS OF THE MIDDLE BEACH.

Cakile edentula (Bigel.) Hook (= *C. Americana* Nutt.) American Sea-rocket. The character plant of the middle beach.

Euphorbia polygonifolia L. Spurge.

Corispermum hyssopifolium L. Bug-seed.

The distribution of these plants is not at all uniform over the middle beach. Their favorite place for growth is along the line of debris which marks the upper limit of this beach. This limit is variable from year to year, depending partly upon the number and violence of the storms, more definitely upon the advance or recession of the lower beach.

PLANTS OF UPPER STRETCHES OF BEACH.

Populus balsamifera candicans (Ait.) Gray. Balm of Gilead. Rare.

Lathyrus maritimus (L.) Bigel. Beach Pea.

Thalesia fasciculata (Nutt.) Britton. (= *Aphyllon fasciculatum* A. Gray.)

Root parasite on the Artemisias.

Artemisia caudata Michx. Wormwood.

Artemisia Canadensis Michx.

Both species of *Artemisia* are abundant, being the dominant form at times over extended areas. The most characteristic species.

Carduus Pitcheri (Torr.) Porter. (= *Cnicus Pitcheri* Torr.)

This thistle, while seldom so common as *Artemisia*, is pretty sure to be found on any upper beach.

Certain plants, especially characteristic of embryonic dunes, are found, though rarely in great abundance, upon the upper stretches of the beach. Among these are *Ammophila arenaria*, and *Elymus Canadensis*. *Calamagrostis longifolia*, one of the chief character plants of active dunes, is also sometimes found in this locality. *Cakile edentula* and *Corispermum hyss-*

sopifolium also occur, but are less abundant than on the middle beach. The shrub life of the upper beach stretches is sparse, the forms are relatively scattered, while the plant body is stunted and bears visible signs of the severe environment. The shrub of most common occurrence is the sand cherry, *Prunus pumila*. Poplars occasionally occur, the forms being the cottonwood, *Populus deltoides* and *P. balsamifera*, both the type and the variety *candicans*. The willows maintaining themselves in this situation are *Salix fluviatilis*, *S. glaucophylla* and *S. adenophylla*.

PLANTS OF ACTIVE DUNES.

Equisetum hyemale L.

Andropogon scoparius Michx. Beard Grass.

Ammophila arenaria (L.) Link. (= *A. arundinacea* Host.) Sea Sand-reed.

Calamovilfa longifolia (Hook) Hack. (= *Calamagrostis longifolia* Hook).
Reed Bent grass.

Elymus Canadensis L. Wild Rye.

Populus deltoides Marsh. (= *P. monilifera* Ait.) Cottonwood. A very common form in this situation.

Salix fluviatilis Nutt. (= *S. longifolia* Muhl.).

Salix glaucophylla Bebb.

Salix adenophylla Hook.

Prunus Virginiana L. Choke-cherry.

Vitis cordifolia Michx. Frost-grape.

Cornus stolonifera Michx. Red-osier. Dogwood.

Cornus Baileyi Coult. and Evans.

Asclepias Syriaca L. (= *A. Cornuti* Decris.). Common Milkweed.

Lithospermum Gmelini (Michx.). A. S. Hitchcock. (= *L. hirtum* Lehm.) Puccoon.

Solidago Virgaurea Gilmani (Gray) Porter. (= *S. humilis Gilmani* Gray.)

Corispermum hyssopifolium L. Bug-seed.

PLANTS OF THE BASSWOOD DUNES.

Hepatica Hepatica (L.) Karst. (= *H. triloba* Chaix.) Liver-leaf. Hepatica.

Sassafras Sassafras (L.) Karst. (= *S. officinale* Nees and Eberm.)
Sassafras.

Hamamelis Virginiana L. Witch-hazel.

Rosa acicularis Lind. (= *R. Engelmanni* S. Wats.)

Ptelea trifoliata L. Shrubby Trefoil. Hop-tree.

Rhus aromatica Ait. (= *R. Canadensis* Marsh.) Sweet-scented Sumach.

Rhus radicans L. (= *R. Toxicodendron* of American authors in part.)
Poison Ivy. Poison Oak.

Celastrus scandens L. Wax-work. Climbing Bitter-sweet.

Vitis cordifolia Michx. Frost or Chicken-grape.

Parthenocissus quinquefolia (L.) Planch. (= *Ampelopsis quinquefolia* Michx.) Virginian Creeper.

Tilia Americana L. Basswood. This is the characteristic tree of this type of dune.

Fraxinus Americana L. White or Gray Ash.

Vagnera trifolia (L.) Morong. (= *Smilacina stellata* Desf.) False Solomon's Seal.

Smilax hispida Muhl. Greenbrier. Catbrier.

Ostrya Virginiana (Mill) Willd. Hop-hornbeam. Ironwood.

Celtis occidentalis L. Hackberry. Sugarberry. The form is the low straggling shrub that is given in Gray's Manual, Sixth Edition, as variety *pumila*.

"One of the most remarkable features of the basswood dunes is the luxuriant development of lianas. Scarcely anywhere away from the river bottom forests is there such a development of climbers as in this region. *Celastrus scandens*, *Vitis cordifolia* and *Rhus radicans* occur almost everywhere. *Parthenocissus quinquefolia* and *Smilax hispida* are not uncommon. The great liana development may be correlated, perhaps, with the dense growth of trees."¹

PLANTS OF EVERGREEN DUNES.

Pinus Strobus L. White Pine.

Pinus divaricata (Ait.) Sudw. (= *P. Banksiana* Lam.). Gray or Northern Scrub Pine. The character tree of this type of dune.

Juniperus communis L. Common Juniper.

Juniperus Virginiana L. Red Cedar.

Andropogon scoparius Michx. Beardgrass.

Prunus pumila L. Dwarf Cherry.

Hudsonia tomentosa Nutt.

Lepargyrea Canadensis (L.) Greene (= *Shepherdia Canadensis* Nutt.).

Epigaea repens L. Ground Laurel. Trailing Arbutus.

Gaultheria procumbens L. Creeping Wintergreen.

Arctostaphylos Uva-Ursi (L.) Spreng. Bearberry. The character shrub of the evergreen dunes.

Lithospermum Gmelini (Michx.) A. S. Hitchcock (= *L. hirtum* Lehm.). Puccoon.

Melampyrum lineare Lam. (= *M. Americanum* Michx.). Cow Wheat.

Solidago nemoralis Ait. Goldenrod.

Solidago Virgaurea Gillmani (Gray) Porter (= *Solidago humilis Gillmani* Gray).

Aster lavis L. Blue Aster.

¹ Cowles, H. C.—*The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan*.—Bot. Gaz., Vol. 27, No. 5, p. 362.

PLANTS OF OAK DUNES.

- Pteris aquilina* L. Common Brake.
Koeleria cristata (L.) Pers.
Cyperus Schweinitzii Torr.
Carex Pennsylvanica Lam. Sedge.
Carex umbellata Schk.
Carex Muhlenbergii Schk.
Tradescantia Virginiana L. Common Spiderwort.
Salix humilis Marsh. Prairie Willow.
Quercus velutina Lam. (= *Q. coccinea tinctoria* Gray). Yellow-barked or Black Oak.
Quercus coccinea Wang. Scarlet Oak.
Quercus rubra L. Red Oak.
Quercus alba L. White Oak. Somewhat characteristic of these dunes.
Aquilegia Canadensis L. Wild Columbine.
Sassafras Sassafras (L.) Karst. (= *S. officinale* Nees and Eberm.) Common Sassafras.
Arabis lyrata L. Rock-cress.
Hamamelis Virginiana L. Witch-hazel.
Rosa blanda Ait. Wild Rose.
Rosa humilis Marsh.
Amelanchier Canadensis (L.) Medic. Shad-bush. Service-berry.
Lupinus perennis L. Wild Lupine.
Cracca Virginiana L. (= *Tephrosia Virginiana* Pers.). Goat's Rue. Hoary Pea.
Euphorbia corollata L. Spurge.
Rhus copallina L. Dwarf Sumach.
Helianthemum Canadense (L.) Michx. Frost Weed. Rock Rose.
Viola pedata L. Bird-foot Violet.
Opuntia humifusa Raf. (= *O. rafinesquii* Engelm.). Prickly Pear.
Oenothera rhombipetala Michx.
Cornus florida L. Common Flowering Dogwood.
Vaccinium Pennsylvanicum Lam. Dwarf Blueberry.
Vaccinium vacillans Kalm. Low Blueberry.
Phlox pilosa L. Wild Phlox.
Monarda punctata L. Horse Mint.
Viburnum acerifolium L. Arrow-wood. Maple-leaved Viburnum.
Ionactis linariifolius (L.) Greene (= *Aster linariifolius* L.).
Helianthus divaricatus L. Wild Sunflower.

In very open places in the oak dunes the following species also occur :

- Festuca octostora* Walt. (= *F. tenella* Willd.). Fescue Grass.
Polygonum tenue Michx.

Polygonella articulata (L.) Meisn.

Mollugo verticillata L. Indian Chickweed. Carpetweed.

Tulinum teretifolium Pursh.

Draba Caroliniana Walt. Whitlow Grass.

Linaria Canadensis (L.) Dumont. Toad Flax.

Adopogon Carolinianum (Walt.) Britton (= *Krigia Virginica* Willd.).
Dwarf Dandelion.

The *Mesophytic flora* evidently consists of all those plants growing in medium or average conditions, and embraces the large majority of the plants of the State. It is extremely difficult to separate this large group in any satisfactory way, since as no extremes of condition exist overlapping is extremely apt to occur. The more thoroughly the distribution of the plants of the State is studied, the less possible does it seem to break up the mesophytic group into smaller groups, standing for definite soil or light conditions. In as uniform an area as Indiana there is no environmental obstacle worthy of mention to the spread of any given species throughout the state.

TIMBER AND TIMBER AREAS.

The uses of forest areas are so manifold and so apparent that little need be said concerning them. Aside from any of the remoter advantages, however, a consideration of forests as a direct source of wealth justifies a careful study of those conditions which best serve for their development, of proper methods for the conservation of existing areas and of species suitable for the reforestation of special regions. Much of the land of the State, now utterly valueless, could be made to yield handsome revenues in the future if properly planted to trees. Existing areas could be made to steadily increase in value, while yielding a constant income if wisely managed. Every year owners of timber lands, either through carelessness or ignorance are wasting valuable property. Concerning the market value of the various crops which his farm produces, the farmer is generally well posted, but concerning the market value of the various trees making up his timber-land, he is usually ignorant. The possible uses to which the various species may be put do not enter into his calculations, nor does he often consider the probable increase in value of special forms, because of the introduction of new industries. The amount of timber that has been allowed to go to utter waste in the past history of the State, would have been sufficient, if it had been preserved until the present and sold at current prices, to have paid for every acre of land in the State. Even yet, in almost every county, valuable timber is being constantly de-

stroyed because of ignorance of the special uses to which special species may be put. It was, of course, necessary to reduce the original timber lands in order to gain agricultural areas. But the demand for crop areas being satisfied, the remaining timber lands should be so treated as to secure their constant reproduction and betterment.

Originally, seven-eighths of the 21,637,760 acres, comprising the area of the State, was covered with a dense growth of timber. Many of the most valuable hardwood forms reached their maximum development, both as regards size and number, within the bounds of the State. No later than 1880 Indiana was sixth in rank among lumber producing States. It is doubtful if there now exists in the State over 2,000,000 acres of timber and from this area much of the most valuable has been removed, so that what remains can but little more than remind us of the wealth of the past. Most of our timber areas are second growth, containing only occasional forms representing the original forests. Very few "virgin forest" areas are now to be found in the State, most of them being confined to the hill regions of the southern counties, where transportation difficulties have led to their remaining untouched until the present.

FORMS HAVING AN ECONOMIC VALUE.

Of the one hundred and thirteen species of trees found within the bounds of the State, seventy-five are of use in manufactures and hence have a market value. Of this latter number, forty-eight are of such general use as to be classed as of the first rank. Over two-thirds of the species of this group of high-grade timber are found throughout the entire State in considerable numbers, if we except the limited areas known as "barrens" and "prairies." Among these are the various forms of oaks, hickories, walnuts, ashes, maples, the tulip poplar and the bald cypress, although the last named, being confined to the swamp regions of the southwestern counties, is of much less general distribution than the others. In some cases the real value of the form is not fully appreciated as in the case of the lins and buckeyes, both of which are usually considered of but little value, unless it be for fuel. The lin, however, has a high value because of its use in the manufacture of woodenware and other products not requiring great strength, while the wood of the buckeye is used almost exclusively in the manufacture of artificial limbs, for which, indeed, it is preferred to any other wood. The black locust and the honey or sweet locust are also forms which locally have not been assigned their true value. In both forms the wood is very heavy, dense and hard, and has few superiors

from an economic standpoint. Most of the remaining forms of the group are of little or no commercial value. The fact that they are the parents of some of the first importance is, however, a sufficient argument for the careful preservation of these apparently worthless forms. It is unnecessary to mention these forms in detail; in a general way they may be considered as including all the larger species for which at present there seems to be no demand. The present impoverishment of our flora is a very large part the result of the neglect of such preservation on the part of preceding generations of landowners.

REFORESTATION.

The removal of the timber covering has brought about in many regions of the State marked physical changes. Changes so great in some cases as to completely change the agricultural capacity of the soil. Denuded hills have their soil carried by the rains to lower slopes and their slopes become warred with constantly increasing gullies and rages. In other places the soil water level has been lowered, in a case of the increased evaporation of water from the soil, brought about by the removal of the forest covering. In such cases the soil soon becomes valueless for agricultural purposes, and is allowed to run to waste, often becoming a center from which noxious weeds are disseminated. The recovery of such areas is possible through reforestation. The most satisfactory species for such reforestation must be determined, largely, by local conditions, in part, perhaps, by the purpose in view. The recovering of a denuded area with forest vegetation is one problem, to recover it with such forms as will have a merchantable value in a reasonable time, is an entirely different matter. There are really two kinds of reforestation desirable in Indiana. The re-planting of denuded areas about dwellings and school houses and along roadsides, and that which is a genuine reforestation, the reclaiming of areas which have been made waste land because stripped of the timber. The two problems are evidently different and the procedure must necessarily differ.

In the first case, what is desired is to secure shapely trees, which furnish good shade and are without bad habits, such as root sprouting, frequent dropping of parts or liability to visitation by insect pests. Native trees are by far the most desirable for this purpose, since they are of all forms the most perfectly adapted to our conditions. In entering upon this work two or three things should be borne in mind. One of these is the fact that rapidly growing forms are usually short-lived and are especially apt to become unshapely unless receiving spe-

cial attention; they are also more liable to injury than species maturing more slowly. Another is, that transplanting is preferably to be done in the early spring before the buds open, February, perhaps, being the best month in our region. Of course, trees transplanted at other seasons will live if proper care is taken, but the chances of success are much greater in cases of spring planting. In taking up the tree for transplanting care should be taken to keep the root system as nearly intact as possible, not so much the strong roots, which serve merely as hold-fasts, as the smaller, fibrous roots, which have to do with absorption. It should also not be forgotten that the roots should be kept moist from the time of removal from the earth until they are transplanted. If these precautions are observed and a sufficiently large hole prepared for the tree, transplanting can be done with a reasonable certainty of success.

Among the best of the native trees for street and roadside are the "sugar maple," "red maple," "linden or basswood," and "white or American elm." Each of these responds readily to proper treatment, and, if not crowded, develops a broad crown and dense foliage. All bud early in the spring and retain their leaves until late in the autumn.

For yards and lawns there may be added with success the "tulip poplar," "black cherry," "red oak," "willow oak" or "sweet gum." If judiciously planted there is secured not merely a suitable shade but also a most artistic effect. I am inclined to add to this list some of the "haws," the "dogwood," the "red-bud" and "service berry," because of their beauty in flower and fruit. Suitably distributed they are very effective in lawn decoration.

In special locations, the sycamore, black walnut, black birch, white ash, beech and chestnut are especially desirable. All of the forms suggested above have under repeated tests proved their suitability for the purposes indicated and are among those recommended by the United States Department of Agriculture.

Certain forms, and forms largely used because of their easy transplanting and rapid growth, should never be planted save in places where nothing else will grow. These are the silver maple, the box elder and the Carolina poplar. There is scarcely a bad plant habit which these forms do not exemplify, and while their rapid growth during the first few years makes them seem most promising, in later years the problem becomes that of their extermination. In sand regions, where no other tree will grow, the Carolina poplar is able to maintain itself and serves to bind the loose soil together so that later other plants are able to secure a foothold. In such cases it is doubtless a

desirable form, but in all others it should be rejected despite the specious arguments of the peripatetic tree agent.

Where large areas are to be set to timber the immediate ends sought should be, by the development of a plant covering, to prevent the waste and impoverishment of the soil by the ordinary agents of degradation and to secure the conservation and proper distribution of moisture. The remote object should be the growing of a crop having at maturity a market value sufficient to compensate for the labor and time involved.

To successfully handle such areas a knowledge of the forms previously existing in the particular locality is desirable as a guide in the selection of forms to be used. The forests of Indiana were, however, as a rule mixed forests, that is, made up of many different species, no single form dominating a large area. It would follow from this that in most localities almost any desirable form may be successfully cultivated. Many of our economic tree forms can adapt themselves to a fairly wide range of soil and moisture conditions, and, while they may not in some cases reach their maximum development, most of them will make satisfactory growth under conditions apparently quite different from the normal.

The few forms suggested as suitable for reforestation within our bounds are those which have suggested themselves in a somewhat extended inspection of the second growth timbers of the State, as being of general distribution, of a fair range of adaptability and of a high economic value. Being a matter of personal judgment, the list is, of course, more liable to error than if it stood for a consensus of opinion of a number of trained observers. It is probable, however, that when extended areas are considered the list will stand with slight change.

Although the black walnut is naturally found in its highest development in rich lowlands, it is capable of a satisfactory and fairly rapid growth in many other situations. Whole hillsides, which had been stripped of their virgin timber, may be seen in various parts of the State to be now fairly well sprinkled with second growth walnut. This frequent appearance and the subsequent persistence of the black walnut in the second growth of partially or wholly denuded areas suggest it as a suitable form for reforestation purposes in many parts of the State. Its rapidity of growth, when associated with its high commercial value, adds weight to the suggestion. So promising is the form that experiments are already under way, experiments that may be considered of considerable magnitude even in a problem such as that

under consideration. A large manufacturing firm at South Bend has established near that city a walnut plantation of one hundred thousand trees, and these trees are expected to be of marketable size within thirty years. An inspection of the trees last summer, the plantation having been under way for several years, confirms this opinion. The plantation is on high land, in relatively thin soil which rests directly upon sand and gravel, an apparently unfavorable condition, and yet the trees were of good size and of thrifty appearance.

If the black walnut is used for reforestation, the nuts should be germinated before planting. As soon as the seedling makes its appearance the nuts should be planted, preferably in rows, and just covered with loose earth. Close planting will tend to develop long-trunked forms, while greater spacing will give a low-branching, short-trunked form. As seedlings appear they may be thinned out from time to time as occasion demands, or vacant places may be reset, thus insuring the desired trunk form. The seedling walnuts need shade during their earlier years, as do the seedlings of most trees, and therefore the planted area should be carefully protected against browsing animals of all kinds for at least five years, in order that the protecting undergrowth may become established. Beyond an occasional clearing of the rows in order to prevent crowding out by more rapidly growing forms, and the care needed to secure the proper trunk form, no cultivation is required.

The sugar maple is another form that establishes itself quickly in almost any soil of the State, and, although a somewhat slow grower, seems able to maintain its own when given proper protection against grazing animals. Other maples maintain themselves as well, but the greater value of the sugar maple makes it the more desirable form.

Upon rolling uplands, with a fairly good sand or clay soil, the ordinary white or gray ash finds its most suitable conditions and would doubtless prove itself a satisfactory form for the reforestation of such areas.

The oaks, also, by their record in the second growth timber, have shown themselves adapted to the re-covering of waste lands. The valuable oaks grow as readily as those that are of less value, and care should be taken to select only those of the first class. In the case of the maples, ash, and oaks, the seeds may be planted in the prepared ground without previous germination. All of the forms germinate readily, and the seedlings are quite hardy.

In almost any warm, dry soil the black cherry makes a good growth and has numerous qualities to commend its use. The only objection

to it lies in the fact that it furnishes a desirable home for certain noxious caterpillars.

The tulip poplar, in certain parts of the State, notably in some of the southern counties, is gaining a foothold among the more common second-growth forms. Its extreme susceptibility to injury, especially in the sapling stage, makes it of doubtful promise in extended replantings. Where, however, the area to be replanted is small, and some care could be given from year to year to the young trees, it would in all probability prove thoroughly satisfactory.

While the conservation and proper distribution of the water of the soil might be accomplished by simply fencing in the waste tracts and giving plants of various kinds an opportunity to gain a foothold, it would seem the part of wisdom, if it were possible, by a little labor and thought, to add, at the same time, to the permanent value of the land. That this end can be accomplished is sufficiently proven by the results that have followed the efforts of the National Forestry Commission in various parts of the country. The paragraphs just preceding are merely suggestions as to reforestation possibilities. If the work is undertaken upon any extensive scale, detailed instructions, as well as valuable assistance, can be obtained from the Chief of the Division of Forestry of the Department of Agriculture.

The reclamation of these waste and wasting areas, a reclamation which is possible at a slight expenditure of time and labor, would add greatly to the wealth of the State, even within the lifetime of a single generation. The successful manufacturer seeks to utilize every by-product; such utilization is to-day a condition of success. The land-owners of Indiana can not afford to leave without an effort at their redemption the thousands upon thousands of acres of waste lands which disfigure the State.

POISONOUS PLANTS.

Plants which may be characterized as poisonous are of two general classes, those which poison by contact and those which are poisonous only when taken into the system. Those of the first class may be again divided into those in which the poisoning is due to some plant constituent and those in which the irritation is due to mechanical causes. These latter cases are sometimes scarcely separable from the former, both factors co-operating in producing the inflammation, but, as a rule, they are easily distinguishable. It must be borne in mind that liability to plant poisoning depends largely upon the thickness of the skin, and largely, also, upon personal idiosyncrasy. Plants per-

fectly innocuous to most persons may prove poisonous to the few who are peculiarly susceptible to plant poisons. A familiar illustration is furnished in the case of the foliage leaves of our ordinary tomato, which most persons handle with impunity, but which in many recorded cases have proved a serious skin poison. As a rule, this susceptibility to contact poisoning can only be discovered through experience, but persons poisoning easily upon contact with the more virulent plants of this type should handle with care certain plants that are considered harmless.

PLANTS POISONOUS BY CONTACT.

This list is very properly headed by the well known Poison Ivy or Poison Oak (*Rhus radicans*). Because of its wide distribution and its various habits of growth, it is probably properly chargeable with a large proportion of the cases of plant poisoning. In most regions of the State it is found as a climber, ascending trees, in some places it trails over rocks by means of rootlets, in others it is a low, erect shrub. It may be readily recognized by its three ovate, sharp-pointed leaflets, the terminal or middle one being wedge shaped at the base. The margins of the leaflets are irregularly wavy or variously notched, scarcely any two being alike. The under surface of the leaflets is usually somewhat downy. The poisonous principle in the plant is a heavy oil and not a volatile substance, as is generally supposed. It is found in all portions of the plant, though perhaps in greater amount in the leaves than elsewhere. The oil is soluble in alcohol but not in water. In cases, therefore, where there is fear that the plant has been touched, the hands should be thoroughly washed in strong alcohol as soon as possible. The wide distribution of the poison ivy is, in some measure, due to crows, these birds being especially fond of the fruit. The seeds are ejected uninjured and are thus spread over the large areas which the crow covers in his search for food.

More virulent in its action than the poison ivy is the "*Poison Elder* or *Dogwood*." Its more restricted range, however, being confined to swamps, makes it much less dangerous than the former. Many persons who are immune to poison ivy are poisoned severely upon contact with the poison elder. In habit the plant is a shrub, ranging from eight to twenty feet in height, bearing large, compound leaves, somewhat resembling those of the alder, of from seven to thirteen leaflets. The poisonous principle is probably of the same character as that of the poison ivy, although it has not yet been satisfactorily worked out. Botanically, the plant is known as *Rhus vernix*.

It is wise for persons with sensitive skins, or who are at all susceptible to plant poisoning, to avoid handling any of the sumachs. Cases are known, and are, indeed, not uncommon, where severe poisoning has resulted from handling the crimson fruit masses of the ordinary sumach, which is classed as not poisonous. In the cases of this kind seen, the poisoning seemed to originate in the mucous membrane of the lips and thence to spread rapidly over the face.

The forms just mentioned are by far the worst of our plants of this type. The following plants are harmless to many people, but are recognized skin irritants, and should be avoided by those liable to plant poisoning.

All of the spurges (*Euphorbias*) are extremely acrid, so much so, indeed, that they are classed among poisonous plants by many authorities. Loudon says, "Every one is so acrid as to corrode and ulcerate the body wherever applied." The most dangerous form locally is *Euphorbia corollata*, easily recognized by its erect habit and the white petal-like appendages of the involucre. It is largely gathered for decoration and is probably responsible for some cases of poisoning otherwise referred.

Indian Tobacco (*Lobelia inflata*) when applied to the skin produces in many cases a serious and persistent irritation.

The Yellow Lady's Slipper (*Cypripedium hirsutum*) at certain stages, especially about the flowering season, is very irritating to the skin, in some cases producing as serious results as "ivy poisoning." Probably many cases of poisoning attributed to Rhus are properly chargeable to the free handling of this favorite flower.

Poke-berry (*Phytolacca decandra*) is an irritant which affects chiefly the mucous membranes. The green plant and the root are the parts to be avoided. The mature stem and leaves seem to lose their irritating properties, but the root retains them throughout the life of the plant.

The Smartweeds (*Polygonum*) cause burning and itching of the skin, which in some cases persists for a considerable time. The most active forms in Indiana seem to be *P. hydropiper* and *P. punctatum* Ell. (= *P. acre* H. B. K.)

The Indian Turnips (*Arisæma triphyllum* and *A. Dracontium*) are violently acrid and almost caustic in every part. The mere handling of these plants frequently produces intolerable itching and inflammation of the skin.

The Skunk Cabbage (*Spathyema fœtida*) is harmless as to its leaves, but the root is acrid and its handling is almost sure to produce itching

and severe inflammation. It is possible that in many cases where the poisoning is first indicated by itching the inflammation following may merely be the result of scratching.

The May-weed or Dog Fennel (*Anthemis Cotula*) has a juice sufficiently acrid to poison a sensitive skin. Its unpleasant odor, however, is sufficient to prevent its general handling, and only occasional cases of poisoning by this plant have been reported in the State.

Golden-Rods (*Solidago*).—All of the many species of this large and attractive genus are to be regarded with suspicion by those with sensitive skins. The Sweet Golden-rod (*Solidago odora*) has a volatile oil that acts as a decided irritant, and some light cases of poisoning seem directly traceable to other forms of the genus.

The Fleabane (*Leptilon Canadense*) also contains a volatile oil possessing irritating qualities, and often causes severe inflammation, especially if handled when green.

The fresh bark of the Leatherwood (*Dirca palustris*) applied to the skin causes blisters and sores, which are very difficult to heal. If taken internally, severe vomiting is produced.

The common Virgin's Bower (*Clematis Virginiana*) is an acrid irritant, often producing blisters. Indeed, all species of the genus *Clematis* should be carefully handled, since their acrid juice is almost certain to produce irritation if it comes in contact with mucous membranes.

Of the Buttercups (*Ranunculus*) at least three, the "tall buttercup" (*R. acris*), the "bulbous buttercup" (*R. bulbosus*) and the "cursed buttercup" (*R. sceleratus*) are to be avoided. Their juices cause inflammation and ulceration, often very persistent and difficult of cure. The entire plant, in each case, appears to be poisonous, although the root is especially rich in the toxic substance.

The members of the mustard family (*Cruciferae*) are all well known irritants, and, as might be expected, frequently produce smarting and blistering of sensitive skins.

Various forms of the potato family (*Solanaceae*) are to be regarded with suspicion. The "Jimson" weeds or Thorn Apples (*Datura Stramonium* and *D. Tatula*) have a bad reputation, and are charged with especially affecting the mucous membranes. The purple leaved nightshade is claimed by some to be an even more virulent skin poison than poison ivy. The symptoms are said to be similar to those occurring in poisoning from the ivy, but the poison is much more difficult to completely eradicate from the system. Several experiments have failed

to verify these claims, although some cases of severe poisoning are undoubtedly attributable to this plant.

In all of the plants cited above, the poisonous property is some substance within the plant body. Of the entire number, only two, the poison ivy and poison elder, are to be regarded as generally poisonous. The others act as poisons only exceptionally, affecting persons with delicate, sensitive skins, or those who, for some reason not understood, are peculiarly susceptible to plant poisons.

As anything may be regarded as a poison which produces an irritation or inflammation of the skin, it is proper to include some plants which, through mechanical contrivances, produce much the same effects as do those possessing a poisonous principle.

The cockle bur (*Xanthium strumarium*) acts as a skin irritant on account of the dust and hairs with which it is covered.

The Burdock (*Arctium Lappa*) is irritating apparently almost entirely because of its defensive armor. The leaves irritate because of their roughness and the burs on account of the sharp, fragile spinous processes. These latter work their way into the skin, producing great irritation and often festering sores.

In this class, also, are to be put the thistles (*Carduus*), although the irritation produced by them is usually much more transient than that caused by the burdock.

The common Nettle (*Urtica gracilis*) and the Wood-nettle (*Urticastrum divaricatum*) possess stinging hairs and also an acid principle, the two combining to produce the intolerable burning which follows the lightest handling of either of these plants. The best treatment is a persistent bathing of the affected parts in cold water, this soon relieving the burning and reducing the inflammation.

The common Mullein (*Verbascum Thapsus*) produces irritation by the action of its woolly hairs. So vigorous is this action that its leaves are often applied externally to the throat as a counter-irritant.

Plants of this type, however, are readily recognized as skin irritants, and are therefore much less likely to work harm than those of the first class.

PLANTS POISONOUS WHEN TAKEN INTO THE SYSTEM.

In this class of poisonous plants the first rank is easily taken by the Spotted Cowbane or Water Hemlock (*Cicuta maculata*). It is found throughout the State in swamps or low grounds, and is so virulent in its effect that it should be recognized at sight. It is only by this general recognition of the plant and a knowledge of its poisonous

properties that its extermination can be secured. The water hemlock is a smooth, stout plant, ranging in height from two to six feet; the stem is usually streaked with purple; the leaves are as a rule doubly compound, the lower leaflets having long petioles; the leaf segments are from one to five inches long, rather narrow and sharp-pointed, with coarsely toothed margins; the fleshy, tuberous root is succulent and pleasantly aromatic, both features attracting browsing animals. In some cases children and adults, tempted by the pleasant odor, have eaten the root, serious results following in all cases. Where the amount eaten was large or the remedial treatment tardily given, death has resulted. "The plant owes its poisonous properties to a volatile liquid alkaloid, coniine, united with a crystalline alkaloid, conhydrine."¹

In man the symptoms are those of general muscular weakness deepening into paralysis. In some cases stupor, coma and slight convulsions have been noted. In the case (cited by Blyth) of a patient who had eaten hemlock in mistake for parsley, a weakness of the lower extremities, causing staggering in walking, followed in twenty minutes; within two hours there was complete paralysis, and death ensued in three and a quarter hours. The whole plant is poisonous and its specific alkaloid destructive to all forms of life.

It is by far the safest way to avoid all forms of the Umbellifer family, to which the water hemlock belongs, which are found growing wild, and this despite a resemblance in appearance and odor to harmless or even edible cultivated forms. While no other species is so virulent, there is scarcely one which does not possess poisonous properties. In some cases the poison is distributed throughout the plant body, in others, localized in special parts. Fortunately the characters of the family are such as to lead to its ready recognition in almost any stage of growth. The members of the family native in Indiana are all herbaceous plants, varying in height from a few inches to ten feet or more. The leaves, which are usually compound, are much divided and dissected. The leaf-stalks (*petioles*) are expanded or sheathing at the base. The stem is usually hollow. The flowers, which are small and inconspicuous, are either white or yellow in color, and are arranged in umbel-like clusters. A study of the common carrot or parsnip will serve to emphasize these characters. The arrangement of the flowers, taken in connection with the hollow stem and compound leaves with expanded or sheathing petioles, furnishes sufficiently accurate means for recognizing the family. While it is true that some species are

¹ Blyth, A. W.—*Poisons; Their Effects and Detection*, p. 250.

and can be attacked with a large or portion of them without an actual rupture to skin that it is wise to avoid eating any portion of wild fruits which possess the structure given above.

Another fact is many members of wild animal poisonous elements, & the most fatal. The poisonous element in this family is usually a narrow channel. The poison may be distributed throughout the plant or it is more commonly the case in the plants of this family in the area the family was limited to leaf and seed. Familiar examples are the nightshade, Jimson-weed and horse-radish. The plants of this family may be recognized by their characteristic rank with exalted to their foliage when crushed, and by the flower which in most of the wild species closely resembles that of the common potato.

Many other plants which are poisonous if taken internally, possess an acid or other juice which prevents their being eaten in excess. The great majority of cases of poisoning of this type reported as having occurred in the State have been caused by the mingling of the edible forms with those usually collected for "greens." This gathering is usually delegated to children, and it is little wonder that serious results at times occur, when we recall the fact that a plant may differ greatly in general appearance in its immature and mature stages. In view of the ease with which greens may be raised in the vegetable garden, the seeking after the less palatable wild forms is without the shadow of an excuse.

Very few of our wild fruits are seriously poisonous. In almost every case the unpalatability of the form prevents the eating of a sufficient quantity to produce fatal or even serious results. While there may be a temptation to taste an attractive looking wild fruit, the taste is usually sufficient to preclude any danger of over-indulgence. The danger of poisoning from wild fruits is very greatly exaggerated in the popular mind.

The prevailing idea that poisonous plants have something repulsive in their appearance which serves to put even the unwary on their guard against them is not borne out by facts. Many of our poisonous plants of both types are among our most beautiful native forms. The best protection against dangers from plants of this character is to be found in a knowledge of the life forms which surround us, a practical sort of knowledge which has been very strangely omitted from the courses of study in many schools. As intelligence increases the amount of danger to human beings from plant poisoning becomes less and less. Indeed, it is now reduced to such an extent as to scarcely deserve comment. In the case of stock, however, conditions are dif-

ferent, and there are plants which should be known to every owner of stock, in order that he may guard against them.

Not all poisonous plants are injurious when taken internally by stock, as is illustrated by the various species of poisonous sumachs, the foliage of which is eaten by many kinds of stock with impunity and even with considerable relish. Other plants known to be internal poisons are not here considered because they are never, so far as reports go, eaten by stock of any kind.

Serious effects are often produced in a mechanical way by various plants, as in the case of certain grasses with sharp, barbed awns, in which the awns may work their way into the mouth and throat and cause such intense suffering that the animal must be killed. Other plants operate by clogging up the intestines, by inflaming the tissues of the eyes, the nose or the mouth and intestinal tract, and perhaps by evolving gases which distend the stomach to such an extent that it is impossible for the heart and lungs to perform their functions. As these plants, however, act merely mechanically, containing no poisonous element, they are not here included.

A few plants not actually poisonous to stock are included, because when eaten they taint the milk or impart a disagreeable quality to the flesh of the animal. Wild garlic or onion is a familiar example of a plant which taints milk. Stock eat this obnoxious or deleterious vegetation largely because of unfamiliarity with the forms. The odor and taste of plants ordinarily eaten by animals are so varied that it is little wonder that an animal when placed among plants with which it is unfamiliar will make an occasional mistake. Another cause of poisoning is the use of impure or unclean hay. Grass and meadow hay are very likely to contain poisonous plants. While usually rejected by the animal, they may, either because of hunger or similarity in structure, be eaten. As this cause may be removed by intelligence and care, it is only necessary to call attention to it in this connection.

The problem of establishing the connection between a specific plant and an equally specific instance of stock poisoning is not always a simple one. Very many observations are necessary and the co-operation of the farmer, the veterinarian, the chemist and the botanist will be found needful in most cases. I would be very glad to receive specimens of plants supposed to be poisonous, together with facts touching the conditions under which the poisoning occurred, the symptoms shown and the kind of stock most likely to be affected. The subject is of such importance that it should be carefully worked in every detail. While the stock losses in Indiana from plant poison-

ing are not so great as in the relatively wild regions of the West, still there is an annual loss from this cause amounting to some thousands of dollars. Farmers should know the following plants and see that they are exterminated in lands used for pasture. The lists have been compiled from the Preliminary Catalogue of Plants Poisonous to Stock, by V. K. Chestnut, of the United States Department of Agriculture. All of the forms included occur in greater or less abundance in the State. The character of soil in which they grow is indicated in the catalogue proper.

I. PLANTS KNOWN TO BE POISONOUS TO STOCK.

- American white hellebore. (*Veratrum viride* Ait.)
- Slender nettle. (*Urtica gracilis* Ait.)
- Pokeweed. (*Phytolacca decandra* L.)
- Corn cockle. (*Agrostemma Githago* L.)
- Common larkspur. (*Delphinium tricorne* Michx.)
- Field larkspur. (*Delphinium consolida* L.)
- Cursed crowfoot. (*Ranunculus sceleratus* L.)
- Celandine. (*Chelidonium majus* L.)
- Wild cherry. (*Prunus serotina* Ehrh.)
- Rattle box. (*Crotalaria sagittalis* L.)
- Locust tree. (*Robinia Pseudacacia* L.)
- Climbing bittersweet. (*Celastrus scandens* L.)
- Water hemlock. (*Oicuta maculata* L.)
- Poison hemlock. (*Conium maculatum* L.)
- Milk weed. (*Asclepias Syriaca* L.)
- Jimson weed. (*Datura Stramonium* L.)
- Jimson weed. (*Datura Tatula* L.)
- Black nightshade. (*Solanum nigrum* L.)
- Sneezeweed. (*Helenium autumnale* L.)

II. PLANTS PROBABLY POISONOUS TO STOCK.

- Bracken fern. (*Pteris aquilina* L.)
- Yew. (*Taxus minor* (Michx.) Britton.)
- Lily of the valley. (*Convallaria majalis* L.)
- White baneberry. (*Actea alba* (L.) Mill.)
- Red baneberry. (*Actea rubra* (Ait.) Willd.)
- Wind flower. (*Anemone quinquefolia* L.)
- Bulbous crowfoot. (*Ranunculus bulbosus* L.)
- Tall crowfoot. (*Ranunculus acris* L.)
- Large flowered yellow flax. (*Linum rigidum* Pursh.)
- Spurge. (*Euphorbia* various species.)

- Buckeye. (*Aesculus glabra* Willd.)
 Spotted St. John's-wort. (*Hypericum maculatum* Walt.)
 Cowbane. (*Oxypolis rigidis* (L.) Britton.)
 Water parsnip. (*Sium cicutaefolium* Gmel.)
 Pimpernel. (*Anagallis arvensis* L.)
 Potato. (*Solanum tuberosum* L.)
 Spring cocklebur. (*Xanthium spinosum* L.)
 Broad cocklebur. (*Xanthium strumarium* L.)

III. PLANTS SUSPECTED OF BEING POISONOUS TO STOCK.

- Field horsetail. (*Equisetum arvense* L.)
 Crow poison. (*Nothoscordum bivalve* (L.) Britton.)
 Oak. (*Quercus* various species.)
 Sleepy catchfly. (*Silene antirrhina* L.)
 May apple. (*Podophyllum peltatum* L.)
 Trailing arbutus. (*Epigaea repens* L.)
 Spreading dogbane. (*Apocynum androsæmifolium* L.)
 Indian hemp. (*Apocynum cannabinum* L.)
 Butterfly weed. Pleurisy weed. (*Asclepias tuberosa* L.)
 Bittersweet. (*Solanum dulcamara* L.)
 Slender gerardia. (*Gerardia tenuifolia* Vahl.)
 Hedge hyssop. (*Gratiola officinalis* L.)
 Common lousewort. (*Pedicularis Canadensis* L.)
 Indian tobacco. (*Lobelia inflata* L.)
 Brook lobelia. (*Lobelia Kalmii* L.)
 Pale-spiked lobelia. (*Lobelia spicata* Lam.)
 Great lobelia. (*Lobelia syphilitica* L.)
 Golden rod. (*Solidago* various species.)
 American cocklebur. (*Xanthium Canadense* Mill.)

Concerning the poisonous properties of the plants in the first list there is no question; concerning those in lists two and three there is a need of further observation, which can only be furnished by stock-owners. Self interest would seem to be a sufficient motive to inaugurate a careful study of these suspected plants.

WEEDS.

From the standpoint of economics, perhaps the most interesting botanical question is that which touches the control of weeds. It is a problem, the terms of which are constantly changing as conditions change, and one which will probably never be satisfactorily settled. It can, however, be made a much less serious matter by the exercise

of constant care and intelligent foresight. There is a very grave question as to whether any so-called "weed laws" will be of much avail so long as there is so little definite knowledge of plants and of the laws governing plant growth.

A weed may be defined as a plant which contests with man for the possession of the soil. It is more than a "plant out of place;" it is a plant fighting for a place. The great majority of our native plants do not rise to the plane of weeds in the usual acceptation of that term. The list of those which make a constant and vigorous fight against man's supremacy is comparatively short in any given area, and the forms may be easily recognized, their number rarely exceeding twenty or thirty. The habits of life, the methods of seed dissemination, the conditions of germination of these forms should be known by every agriculturist if he hopes for the best results from his labors.

That a plant may make this semi-successful fight, it must possess certain qualities which give it advantage in the struggle for existence, whether the struggle be against existing plants, browsing animals or man himself. Weeds must be able to adapt themselves to a wide range of merely physical conditions, such as soil character, both as to its chemical composition and physical constitution, to sharp differences in the water content of the soil, and to variations in temperature and light exposure. Very few plants, relatively, have such range, but those that have are weeds, unless by chance man has taken them for his own use as crop or forage plants. A plant to be a crop plant must originally have been capable of adapting itself to this wide range of conditions. It is true that in such plants man has, through cultivation, wrought changes, that as a rule, they now require care for their proper development, but this was simply a matter of exchanging one quality for another. Originally, then, weeds and crop plants were very much alike in this matter of plasticity, and it is little wonder that they come in conflict for the possession of the soil. Any plant, then, having this power of adaptation possesses one of the essential qualities of a weed.

The strange plant which the farmer recognizes as growing in rich or poor soil, in dry or moist places, in the shade or in the open sunlight, holding its own in all of these situations, has in it the potentialities of a weed, and that which may be the curiosity of to-day may be the pest of to-morrow. A few years ago a plant was sent me which I recognized at once as the Russian thistle. The letter informed me that a single plant had been found growing in a field near the railroad. Suggestion was made that the plant be destroyed before it set seed, but the advice was not followed. The next year two wagon loads of

Russian thistle were taken from the field. The farmer should be constantly upon the alert for the first appearance of these strange plants and should promptly destroy any suspicious form. It is at the time of the first appearance of a weed that the work of control should begin.

A weed, also, if it rises to the rank of a "bad weed," must be able to maintain itself against enemies in the form of browsing animals. This defense may be secured in manifold ways. It may be through defensive armor, as in the thistle, through a thick covering of hairs, as in the mullein, through a toughness of fiber, as in most composites, through an acrid juice, as in the smartweeds and spurges, or through irritating mineral crystals, as in the Indian turnip. If, in addition to the power of adaptation mentioned above, the plant by any means is able to repel browsing animals, it has gained an immense advantage in the struggle for existence, and is on the high road to weed eminence.

Plants, also, have other means of propagation than that furnished by seeds. Many of our worst weeds are such because they multiply not merely by means of seed, but also by means of root stocks or runners. In cases of this kind, mere destruction of the seed will not serve to exterminate or even limit appreciably the spread of the pest. Before any rational method of extermination can be employed, it is evidently necessary to understand the means by which the particular species is propagated.

In many weeds, the annoying abundance is due to the means of distribution of the seed and fruit. Beggarlice, burdock, Spanish needles and stickights cling to the coats of stock and are thus distributed; the milkweed, the thistle and a host of other composites are distributed by the wind, while other forms are distributed by birds and grain-eating animals.

A weed is a weed, therefore, because it has a wide range of adaptation in respect to physical factors, possesses efficient defensive devices, propagates readily, often by several methods, and has, as a rule, especially effective means of seed dispersion. Any plant possessing these properties is liable to become troublesome.

In a general way it may be said that the chief characteristic of weeds is a rapid and vigorous stem growth. In case the stems are erect this rapid growth brings the plant into the proper light relation and serves at the same time to shade other plants and retard their growth. Where the stems are not strong enough to maintain themselves in an erect position, they may form a mat or carpet over the ground, thus smothering plants of a slower and less vigorous stem growth.

As the proper time to combat a weed is upon its first appearance, the landowner should know the plants of his farm well enough to rec-

ognize the appearance of a new form among them. Such new forms come in largely along railway lines, and it is along the right of way of our great trunk lines that most new species find their way into our flora. Strange forms also often appear along waterways, following generally the course of the current, but sometimes working against it. Less frequently new forms are found entering the State along wagon roads. These, the chief avenues by which weeds are introduced into the State, should be carefully watched if we expect to minimize the weed problem.

The treatment of the different species of weed plants varies of course with their habits. It would be impossible in this connection to discuss each in detail, but a few general principles may be given, which will be found applicable in a large majority of cases. Many weeds, especially biennials or perennials, are exterminated most easily and with the least expense by planting some early, rapidly growing crop which will smother them out. A field with a good set of clover or blue grass shows how effective this method is. In many cases weed-ridden areas can be thoroughly reclaimed by this method with the minimum of trouble and expense.

Planting corn or root crops is a good method of dealing with weeds, since the cultivation given the crops greatly reduces the spread of the weeds. It can not be too clearly understood that the more thorough the cultivation the fewer in number are the weeds. Professor Bailey once said, "Weeds represent, in an inverse way, the energy and intelligence of the farmer. The greater the latter, the fewer the former; the less the latter, the greater in number the former."

Cutting and burning when in an advanced stage of growth prevents production of seed, and to that extent prevents spreading. This method, however, can be applied only in exceptional cases where it is desired to reclaim waste areas or after the crops have been gathered, as a protection against the weeds of the late summer and autumn.

In most cases where the plant is an annual, and the majority of our introduced weeds are annuals, cutting the plant before it sets seed will in a few years bring about its practical extermination. The seeds of but few of our weeds retain their vitality for a longer period than three years, many of them not so long.

Where the plant is a perennial, cutting the growing plant two or three times a year is, perhaps, the most efficient means of getting the plant under control. By this method the excess food material elaborated by the leaves and transferred to the roots for storage is exhausted in sending out new shoots after each cutting, and none is left to carry the plant through the winter and to furnish food supply for

the growth of the shoots of the following spring. At first the labor involved in this method may be very great, but in a short time the weeds will be found to be so reduced in numbers as to be of easy control. Each type of weed requires its particular treatment, and this can only be given when the farmer knows, and knows thoroughly, some of the fundamental laws governing plant growth and reproduction.

The best efforts in cultivated areas will be of little avail if roadsides and waste places are allowed to remain untouched. The manifold methods of seed dispersion will be sufficient to insure the renewal of the weed crop from these sources. A thriftless farmer may add immensely to the labor of his neighbors who are using intelligent efforts to rid themselves of weeds. Co-operation is the secret of success in weed extermination, and in every movement to check the spread of weeds as wide a co-operation as possible should be secured. A little investigation of the monetary loss caused by the unchecked spread of weeds ought to be enough to secure broadly concerted action on the part of landowners in this beneficent work.

Of the making of weed lists there is no end, and such weed lists have a certain local value. No such list, however, can be of very general application because the factors determining plant growth vary so greatly in different localities. The weeds in Indiana which may perhaps be considered the most annoying to the farmer will be found included in the following lists. The relative rank as to badness will vary in different localities, but all named are bad and should be persistently destroyed. In all probability these species will never be completely driven from our area, but their numbers may be so reduced by concerted, intelligent action that they will no longer demand so large a measure of labor for holding in check nor involve such serious financial loss from year to year. In "Gleanings From Nature" (p. 251), Prof. W. S. Blatchley gives the following list named, in his view, "in the order of their injuriousness."

- Ragweed. *Ambrosia artemisiifolia* L.
 Foxtail. *Ixophorus glaucus* (L.) Nash.
 Ironweed. *Vernonia fasciculata* Michx.
 Great ragweed. *Ambrosia trifida* L.
 Pigweed. *Amarantus retroflexus* L.
 Horseweed. *Leptilon Canadense* (L.) Britton.
 Cocklebur. *Xanthium Canadense* Mill.
 Whitetop. *Erigeron annuus* L.
 Lamb's quarters. *Chenopodium album* L.
 Common thistle. *Carduus lanceolatus* L.
 Field sorrel. *Rumex Acetosella* L.

- Purslane. *Portulaca oleracea* L.
 Burchgrass. *Cenchrus tribuloides* L.
 Beggar's ticks. *Bidens frondosa* L.
 Prickly lettuce. *Lactuca scariola* L.
 Crabgrass. *Syntherisma sanguinalis* (L.) Nash.
 Jimsonweed. *Datura Stramonium* L.
 Smartweed. *Polygonum Persicaria* L.
 Bracted bindweed. *Convolvulus Sepium* L.
 Corn cockle. *Agrostemma Githago* L.

The above list is well considered, and contains, perhaps, the worst weeds infesting our area. Their relative rank will, of course, vary with the character of the soil, amount of soil moisture and intensity of cultivation. The first of the weeds in the list, *Ambrosia artemisiæfolia*, is regarded by many farmers as not only not injurious, but as positively beneficial to the land. This belief is especially prevalent in the northern part of the State. As yet, I have been unable to discover the reasons for this belief, and am of the opinion that it has no basis in fact. In many parts of the State the velvet leaf or butter-print, *Abutilon Abutilon* (L.) Rusby, is regarded as the worst of our weeds. It multiplies with extreme rapidity, the quick germination of the seeds and rapid growth of the seedling giving it a great advantage over the plants with which it is usually associated. It is extremely difficult to eradicate and has some real claims to a high rank among weeds. The prickly lettuce, *Lactuca scariola* is not regarded as especially troublesome even where found in abundance, since it yields readily to cultivation and is readily eaten by stock, especially in the early part of the season. Where it has taken possession of a field it can be practically exterminated by converting the field into pasture.

Chicory, *Cichorium Intybus* L., while not widely distributed throughout the State, is locally abundant and very difficult to eradicate when it has once found a foothold. It is especially abundant in the southern counties of the State.

The common burdock, *Arctium Lappa*, is by very many reporters considered entitled to the first rank. It is eradicated with extreme difficulty and its seeds germinate readily in a wide range of conditions touching soil, moisture and temperature. The best treatment is a frequent cutting during the growing season as indicated earlier in this section.

A series of weeds of the lawn also should have place in this connection not so much because of the actual loss they cause as because of the labor needed to protect lawns from their invasion. Among the most persistent are dandelion, common mallow, shepherd's purse, the

plantains, especially *Plantago major*, the creeping spurge, *Euphorbia humistrata*, and in wet soils, "rich weed."

Most of these are low growing forms and can not be cut with the lawn mower. The only remedy seems to be the digging up of the individual plants as they appear from year to year, until the lawn is freed from their presence.

Some roadside weeds, such as the dog fennel, the fetid marigold and some of the coarser verbenas, deserve attention from those in control of highways.

It will be seen that to the list given by Mr. Blatchley, I add:

Velvet leaf, *Abutilon Abutilon* (L.) Rusby.

Chicory, *Cichorium Intybus* L.

Burdock, *Arctium Lappa* L.

Dandelion, *Taraxacum Taraxacum*.

Mallow, *Malva rotundifolia*.

Shepherd's purse, *Bursa Bursa-pastoris*.

Plantain, *Plantago major*.

Plantain, *Plantago Rugelii*.

Creeping spurge, *Euphorbia humistrata* Engl.

Rich weed, *Adicea punila* (L.) Raf.

Dog fennel, *Anthemis Cotula* L.

Fetid marigold, *Dysodia papposa* (Vent) Hitch.

Verbenas, *Verbena* various species.

In certain localities some of these may be replaced by other forms, but taking the State as a whole, it is believed that the above list includes all of the universally bad weeds of our area. When the weed problem is reduced to such simple terms there seems no excuse for not having the annoying forms in fair control in all cultivated areas. The forms will probably never be entirely exterminated, for their wide range of adaptation will enable them to secure a foothold wherever the vigilance of the farmer is ever so slightly relaxed.

NOMENCLATURE.

Without expressing any opinion upon disputed synonymy, it has been thought best in this catalogue to follow the nomenclature of Britton and Brown's *Illustrated Flora of the Northern United States, Canada and the British Possessions*. Where this varies from the Sixth Edition of Gray's Manual, the name used in the latter work is placed in parenthesis. The most marked changes, perhaps, are found in the breaking up of the great families of the *Compositæ*, the *Leguminosæ*, the *Rosaceæ*, the *Ericaceæ*, the *Geraniaceæ*, the *Sapindaceæ* and the

Liliaceae into a series of smaller families of more clearly defined limitations. Some changes in prominent genera also occur, but in the main it will be found that the present arrangement commends itself to the thoughtful student.

The sequence of families is that of Britton and Brown, which in the main, follows Engler and Prantl in their great work *Natürliche Pflanzenfamilien*.

In transferring to this nomenclature it is scarcely reasonable to expect that all errors have been avoided. Great care has been given, however, to this part of the work and it is believed that such errors will only be found exceptionally.

The catalogue, therefore, stands in the latest authorized form both as to arrangement and nomenclature, and will, it is believed, prove of great service to the botanical students of the State.

ACKNOWLEDGMENTS.

In the preparation of this report all published local flora and many manuscript reports have been freely consulted. All data have not been included because of lack of time to study the synonymy of the included species. The lists coming to my hand were named according to the nomenclature of Wood's Botany, Gray's Manual, fifth edition, Gray's Manual, sixth edition, and the "Blue Book" of the Botanical Club of America. As the present catalogue follows the nomenclature of Britton and Brown's recent manual of the botany of the north-eastern portions of North America, the amount of work involved in the examination of these reports becomes apparent. This will explain the absence of some data which have come to my hand; for the most part, these data bear upon regions covered by other and fuller reports. To all these persons who have furnished me local reports I am under many obligations. In most cases the body of the report gives credit to the proper person, although in some cases where data have come from one person and herbarium specimens from another, credit has been given for the latter.

For many facts in connection with the part bearing upon poisonous plants, I am indebted to the Report upon Poisonous Plants, published by Mr. V. K. Chestnut, of the United States Department of Agriculture, and can only regret that time and space did not permit a fuller use of this valuable publication.

From the varied publications of Prof. W. S. Blatchley, much material has been drawn either supplementing data already in hand or in the form of ecologic facts reported from no other source. Mr.

Blatchley has also added very many forms to the flora of the State as the result of his energetic field work and critical studies.

Dr. Robert Hessler has always furnished answers to my numerous inquiries, and has, in many ways, aided in the preparation of this report.

Dr. J. T. Scovell, of Terre Haute, has also placed the results of his investigations at my disposal, and my only regret is that I have been unable to avail myself of his assistance to the fullest degree. Some of his recent studies upon the flora of Lake Maxinkuckee and its surroundings I have been wholly unable to use. They would have added much to the value of the report, but will perhaps have a greater value published as a separate study of a special region.

To Mr. O. M. Meyncke, of Brookville; Mr. G. W. Wilson, to Hon. Francis Walker, of Anderson; Mr. J. N. Jenkins, of North Manchester; Rev. E. J. Hill, of Englewood, Ill.; Dr. J. Schneck, of Mount Carmel, Ill.; the late Elwood Pleas, Esq., together with a large number of other correspondents, I am under large obligations.

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To the many others who have responded to my communications for special information, I make this general acknowledgment, their special services being credited in the body of the report.

In conclusion, I wish to express my appreciation of the aid given by the botanists of the country, who have given freely of their services in the determination of doubtful forms, an aid which gives an added value to the list as published.

There are doubtless errors in the list, for which I accept full responsibility. Many of these errors will, I think, prove errors of omission and concerning these I trust the critic will reflect that they might have been avoided had he responded to the many requests for data made during the past few years. Other errors will doubtless be those of judgment and concerning these I have no excuse to offer. The list as presented is my best judgment as to the constituent members of the State flora, and makes no claim to being the final utterance upon the subject.

BIBLIOGRAPHY OF THE SUBJECT.

- ARTHUR, J. C. Forms of *Xanthium Canadense* and *X. strumarium*. Proceedings of the Indiana Academy of Science, 1895, pp. 100.
- Wild or Prickly Lettuce. Bull. Ag. Exp. Sta., No. 52. (Nov. 1894.)
- A Native White Bedding Plant. Bull. Ag. Exp. Sta., No. 74. (Nov. 1892.)
- BAILEY, LIBERTY HYDE. Limits of Michigan Plants. Bot. Gazette, 7: 105-108. (Sept. 1882.)
- Notes on some Indiana plants.
- BAIRD, JOHN F., and TAYLOR, JOHN L. The Flora of Clark County, Ind. Manual of the Public Schools of Clark County, Ind., for 1878-79, 45-65
- BARNES, CHARLES REID. Notes [on various plants]. Bot. Gazette, 2: 120-121. (July, 1877.)
- Addenda (to Flora of Jefferson County). Bot. Gazette, 3: 13. (Feb. 1878.) Adds three species to previous lists.
- Catalogue of Phenogamous and Vascular Cryptogamous Plants Found Growing Wild in Jefferson County, Indiana, to which is added a list of plants growing in Clark County, but not found in Jefferson, by John F. Baird. 8vo: pp. 9 (?).
- BENEDICT, A. C., and ELROD, M. N. A Partial List of the Flora of Wabash and Cass Counties, with notes. 17th Ann. Rept. Geol. Survey, 260-272 (1892.)
- List of 92 plants.
- BLATCHLEY, W. S. On Weeds in General and Our Worst Weeds in Particular. Indiana Farmer. (8 March, 1890.)
- Includes a list of 20 worst weeds of Indiana, and some account of their origin in the State.
- The Ironweed. Indiana Farmer. (4 October, 1890.)
- Notes on Some Phanerogams New or Rare to the State. Proceedings of the Indiana Academy of Science, 1896, pp. 130-143.
- A Catalogue of the Uncultivated Ferns and Fern Allies and the Flowering Plants of Vigo County, Indiana. 21st Ann. Rep. Geol. Survey (1896), pp. 579-702.
- Gleanings from Nature. Nature Publishing Company, Indianapolis, Ind.

BOTANICAL GAZETTE. Some Big Trees of Indiana. *Bot. Gazette*, 5:69-70. (May, 1880.)

Quotes notes from Case's Botanical Index.

—— Notice of the Catalogue of the Flora of Indiana. *Bot. Gazette*, 6:179. (Jan. 1881.)

Note to effect that work through Compositæ was done by C. R. Barnes, and that remaining work was to be done by editors.

—— Flora of Indiana. Supplement I (April, 1882), pp. 1-4.

List of 43 additions, bringing the number of vascular plants of Indiana to 1,475.

—— New Indiana Plants. *Bot. Gazette*, 8:285. (Aug. 1883.)

Notes four additions to the State flora.

BOWERS, HOMER. A Contribution to the Life History of *Hydrastis Canadensis*. *Bot. Gazette*, 16:73-82. Pl. 8. (March, 1891.)

Notes on life history and probable extinction of the species in Indiana.

BRADNER, E. A Partial Catalogue of the Flora of Steuben County. 17th Ann. Rept. Geol. Survey, 135-159. (1892.)

List of 729 species.

CHIPMAN, W. W. Notes on the Flora of the Lake Region of Northeastern Indiana. Proceedings of the Indiana Academy of Science, 1896, pp. 147-158.

COLLINS, S. H. A Partial Flora of Dearborn County, Indiana, and Vicinity. 16th Ann. Rept. Dept. of Geology and Natural History, 376-382. (1889.)

List of 248 species.

COPELAND, HERBERT E. *Cyclostoma platyphyllum* Moquin. *Bot. Bulletin* (now *Bot. Gazette*), 1:6 (Dec. 1875.)

Notes this plant as established on Fall-Creek. Also *Nasturtium sessiliflorum* and *Dactyloctenium Ægyptiacum* in Indianapolis.

COULTER, JOHN MERLE. *Sullivantia Ohionis*. *Amer. Nat.*, 9:572. (1874.)

Its occurrence near Hanover, with some account of its habitat.

—— Partial List of the Flora of Jefferson County. 6th Ann. Rept. Geol. Survey, 229-277. (1875.)

List of 722 species.

—— *Aster Novæ-Angliæ*. *Bot. Bulletin* (now *Bot. Gazette*), 1:2. (Nov. 1875.)

Notes on habits of plants growing in vicinity of Hanover.

—— *Querci* Near Hanover, Ind. *Bot. Bull.*, 1:2. (Nov. 1875.)

Mentions nine species in vicinity.

—— *Diarrhena Americana* Beauv. *Bot. Bull.*, 1:6. (Dec. 1875.)

Notes occurrence of this plant in Clifty Ravine.

- *Dentaria Laciniata* Muhl. Bot. Bull., 1:8. (Dec. 1875.)
Notes variations of this plant in vicinity; suggest union of species of *Dentaria* under one name.
- An Interesting Herbarium. Bot. Bull., 1:9-10. (Jan. 1876.)
Account of the collection of Dr. Clapp, who collected in the vicinity of New Albany, 1835-36, then preserved by the Natural History Society of that place.
- Some Effects of the Unusual Season. Bot. Bull., 1:11-12. (Jan. 1876.)
Notes blossoming of various plants in December, 1875, in various parts of State.
- Some Plants Noted in Carroll County, Indiana. Bot. Bull., 1:12. (Jan. 1876.)
Notes richness of flora of Wabash Valley.
- Some Early Plants. Bot. Bull., 1:15. (Feb. 1876.)
Notes early blossoming of plants, January, 1876.
- Some Plants New to the Flora of Jefferson County. Bot. Bull., 1:34-35. (June, 1876.)
Notes on the occurrence of numerous plants not included in the two lists of the Geol. Survey.
- Plants New to Jefferson County. Bot. Bull., 1:38. (July, 1876.)
Additional list collected by A. H. Young.
- Some Carices Near Hanover, Ind. Bot. Bull., 1:38-40. (July, 1876.)
List of 24 species, with notes.
- The "Knobs" of Southern Indiana. Bot. Bull., 1:41-42. (Aug. 1876.)
Brief account of the flora of this region in Clark and Floyd Counties.
- *Magnolia acuminata* L. Bot. Bull., 1:44. (Aug. 1876.)
Notes on this species near Hanover, Ind.
- *Conoclea multifida* Benth. Bot. Bull., 1:47. (Sept. 1876.)
Notes on this species from Kirkville, Ind.
- Some River Bank Flowers. Bot. Bull., 1:47. (Oct. 1876.)
Notes on plants growing in the alluvium of the Ohio River, near Hanover, Ind.
- *Aster oblongifolius* Nutt. Bot. Gazette, 2:65-66. (Dec. 1876.)
Notes occurrence in Jefferson County.
- Natural Grafting. Bot. Gazette, 2:137. (Sept. 1897.)
Notes *Carpinus* growing on trunk of *Fagus*, near Hanover.
- *Spermacoce glabra* Michx. Bot. Gazette, 2:137-138. (Sept. 1877.)
Note of station near Hanover.

—— The "Barrens" of Southern Indiana. Bot. Gazette, 2:145-145.
(Oct. 1877.)

Brief account of the flora of these regions, located in Clark, Floyd, Washington and Harrison counties.

—— Some New Stations. Bot. Gazette, 3:24. (March, 1878.)

Notes on rare plants of Clark County.

—— The Flora of Northern Indiana. Bot. Gazette, 4:109-113. (Jan. 1879.)

Notes based largely on a botanizing trip along the L. S. & M. S. R. R.

—— A Natural Botanic Garden. Bot. Gazette, 5:70. (May, 1880.)

Notes on flora of Wabash College campus.

—— A Comparative View of the Flora of Indiana. Bot. Gazette, 6:301-302. (Dec. 1881.)

Gives comparative statistics of the flora of Indiana, Washington, D. C., and Eastern United States.

—— Some Notes on *Physostegia Virginiana*. Bot. Gazette, 7:111-112. (Sept. 1882.)

Notes the flowers as cataleptic.

COULTER, J. M., COULTER, S., and BARNES, C. R. Catalogue of the Phænogamous and Vascular Cryptogamous Plants of Indiana. 8vo, pp. 38. Crawfordsville (1881).

List of 1,432 species.

COULTER, JOHN M., and THOMPSON, HARVEY. Origin of the Indiana Flora. 15th Ann. Rept. Geol. Survey, 253-282. (1886.)

COULTER, STANLEY. On the Size of Forest Trees in Jefferson County, Ind. Bot. Bull., 1:10. (Jan. 1876.)

Notes large trees, especially *Platanus occidentalis*, *Fagus ferruginea*, and *Liriodendron tulipifera*.

—— The Numerical Relations Existing Among the Forest Trees of Jefferson County, Ind. Bot. Bull., 1:15. (Feb. 1876.)

Gives relative abundance in per cents.; *Fagus ferruginea* leads with 35 per cent.

—— The Forest Trees of Cass County, Ind. Bot. Bull., 1:42-43. (Aug. 1876.)

Notes on relative abundance; the *Querci* forming 50 per cent.

—— Note on *Euphorbia marginata*. Bot. Gazette, 2:63. (Dec. 1876.)

Note on naturalization of this plant on Eel River.

—— *Zannichellia palustris*. Bot. Gaz., vol. 12, p. 109. (1887.)

—— The Forest Trees of Indiana, Their Distribution and Economic Value. Trans. Indiana Horticultural Society 1891, 157-192. (1892). Also, separate pp. 36.

List of 108 species with notes on distribution and economic characters.

- Saxifragaceæ in Indiana. Proceedings of the Indiana Academy of Science, 1894, pp. 103-107. Represented in Indiana by nine genera.
- A Report Upon Certain Collections of Phanerogams Presented to the State Biological Survey. Proceedings of the Indiana Academy of Science, 1895, pp. 169-182. Three collections embracing nearly one thousand species.
- Noteworthy Indiana Phanerogams. Proceedings of the Indiana Academy of Science, 1895, pp. 183-198.
- Contributions to the Flora of Indiana, No. IV. Proceedings of the Indiana Academy of Science, 1896, pp. 159-171.
- Exceptional Growth of a Wild Rose. Proceedings of the Indiana Academy of Science, 1896, pp. 189-190.
- Notes on the Germination and Seedlings of Certain Native Plants. Proceedings of the Indiana Academy of Science, 1898, pp. 215-22.
- The Phanerogamic Flora of Indiana. Proceedings of the Indiana Academy of Science, 1893, pp. 193-199.
- Contributions to the Flora of Indiana, No. V. Proceedings of the Indiana Academy of Science, 1897, pp. 158-165.
- COWLES, HENRY C. The Ecological Relations of the Vegetation on the Sand Dunes of Lake Michigan. Bot. Gazette, 27:95-117 (Feb. 1899), 167-202 (March, 1899), 281-308 (April, 1899), 361-391 (May, 1899).
- CUNNINGHAM, ALIDA M. Value of Seed Characters in Determining Specific Rank. Proceedings of the Indiana Academy of Science, 1894, pp. 67-68.
- Certain Chemical Features in the Seeds of *Plantago Virginica* and *P. Patagonica*. Proceedings of the Indiana Academy of Science, 1894, pp. 121-123.
- Distribution of the Orchidaceæ in Indiana. Proceedings of the Indiana Academy of Science, 1895, pp. 198-202.
- A Revision of the Species of the Genus *Plantago* Occurring Within the United States. Proceedings of the Indiana Academy of Science, 1896, pp. 190-206.
- The Ericaceæ of Indiana. Proceedings of the Indiana Academy of Science, 1897, pp. 166-168.
- Indiana's Gentianaceæ. Proceedings of the Indiana Academy of Science, 1897, pp. 168-170.
- Morphological Characters of the Scales of *Cuscuta*. Proceedings of the Indiana Academy of Science, 1898, pp. 212-213.
- Geographical Distribution of the Species of *Cuscuta* in North America. Proceedings of the Indiana Academy of Science, pp. 214-215.

ELLIOTT, THOMAS B. The Trees of Indiana. Trans. Indianapolis Acad. Science, 72-86. (1872.)

(Not seen; inserted on authority of Dr. N. L. Britton's State and Local Floras.)

GEDDES, W. N. Some Great Rag Weeds. Bot. Bull., 1: 14-15. (Feb. 1876.)

Notes on *Ambrosia trifida* 12 to 18 feet high near Hanover.

GORBY, S. S. Geology of Miami County. 16th Ann. Rept. Dept. of Geology and Natural History, 165-188. (1889.)

Includes list of trees and shrubs, pp. 168-170.

HAINES, MARY P. List of Ferns, Mosses, Hepaticæ, and Lichens Collected in Wayne County. 8th, 9th, and 10th Ann. Rept. Geol. Survey, 235-239.

HESSLER, ROBERT. Notes on the Flora of Lake Cicott and Lake Maxinkuckee. Proceedings of the Indiana Academy of Science, 1896, pp. 116-129.

—— The Adventitious Plants of Fayette County, Indiana. Proceedings of the Indiana Academy of Science, 1893, pp. 258-262.

HIGLEY, WILLIAM K., and RADDEN, CHARLES S. The Flora of Cook County, Illinois, and a part of Lake County, Indiana. Bull. Chicago Acad. Sci., II, I-XXIII, 1-168, with map.

Phanerogams and Pteridophytes of Lake County north of the Little Calumet River.

HILL, E. J. Botanical Notes. Bot. Gazette, 6: 259-263. (Sept. 1881.)
Localities for various plants in northern Indiana.

—— *Eleocharis dispar* n. sp. Bot. Gazette, 7: 3. (Jan. 1882.)

From Lake County; referred by Gray's Manual to *E. capitata* R. Br.

—— Notes on Indiana Plants. Bot. Gazette, 7: 187-188. (March, 1882.)

Give stations of new plants from Lake County.

—— Notes on Indiana Plants, 1883. Bot. Gazette, 9: 45-48. (March, 1884.)

Various Lake County stations.

—— Some Indiana Plants. Bot. Gazette, 10: 262-263. (April, 1885.)

Stations in Lake and Porter counties.

—— Some Indiana Plants. Bot. Gazette, 13: 323. (Dec. 1888.)

Notes on certain plants of the northern counties.

—— Notes on the Flora of Chicago and Vicinity. Bot. Gazette, 17: 246-252. (Aug. 1892.)

Notes on a few Lake County species.

—— Notes on the Flora of Chicago and Vicinity. 21: 118-123. (March, 1896.)

Notes on some Indiana species.

——— *Zizia aurea* and *Thaspium aureum*. Bot. Gazette, 23: 121-124. (Feb. 1897.)

——— *Salsola Kali* *tragus*. Bot. Gazette, 19: 506-507. (Dec. 1894.)

——— Two Noteworthy Oaks. Bot. Gazette, 26: 53-57. (July, 1898.)

HUSSEY, JOHN. Regular Flower in *Pedicularis Canadensis*. Bot. Gazette, 4: 166-167. (June, 1879.)

Note on form, from near Lafayette.

LAPHAM, INCREASE A. The Grasses of Wisconsin and the Adjacent States of Iowa, Illinois, Indiana, Ohio and Michigan, and the Territory of Minnesota and the Region about Lake Superior. Trans. Wis. State Ag. Soc., 3: 397-488. (1853.)

MACDOUGAL, D. T. Poisonous Influence of Various Species of *Cypripedium*. Proceedings of the Indiana Academy of Science, 1894, pp. 136-137.

MAXIMILIAN, ALEXANDER PHILIP. (Prince of Neuvied.) [List of trees in vicinity of New Harmony.] *Reise in das innere Nord-Amerika*, 1: 209. (Coblenz, 1839.)

Includes a list of 60 species of trees.

MCBRIDE, R. W. Some Queries Relative to a Supposed Variety of *Solanum dulcamara*. Proceedings of the Indiana Academy of Science, 1893, pp. 232-233.

MEYNCKE, O. M. A Large Red bud. Bot. Gazette, 7: 36. (March, 1882.)

Tree 14 inches in diameter, near Brookville.

——— The Flora of Franklin County. Bull. Brookville Soc. Nat. Hist., No. 1: 13-38 (1885); No. 2: 45-49 (1886).

PHINNEY, A. J. Catalogue of the Flora of Central Eastern Indiana. (Alpine or elevated district of the State.) 12th Ann. Rept. Geol. Survey, 196-243. (1883.)

Mainly from Delaware and Wayne counties.

RIDDELL, JOHN L. Synopsis of the Flora of the Western States. Western Journ. of Med. and Phys. Sciences, 7: 329-374 (Jan. 1835), 489-556 (April, 1835).

Intended to cover Ohio, Indiana, Illinois, West Tennessee, Missouri and Northwest Territories.

List of 1,802 species, including mosses, hepaticæ and lichens.

RIDGWAY, ROBERT. Notes on the Native Trees of the Lower Wabash and White River Valleys in Illinois and Indiana. Proc. U. S. Nat. Mus., —: 49-88. (1882.)

Valuable notes on 92 species of trees.

——— Additions and Corrections to the List of Native Trees of the Lower Wabash. Bot. Gazette, 8: 345-352. (Dec. 1883.)

——— Additional Notes on the Native Trees of the Lower Wabash Valley. Proc. U. S. Nat. Mus., Vol. XVII, pp. 409-421. (1894.)

ROSE, JOSEPH N. *Selinum Canadense* in Indiana. *Bot. Gazette*, 11: 333.
Dec. 1886.

Notes discovery of station of this plant near Crawfordsville.

SCHNECK, J. Flora of the Lower Wabash Valley, Below the Mouth of
the White River. Seventh Ann. Rept. Geol. Survey, 504-579.
1876.

List of 867 species, some of which belong to the flora of Illinois.

— Some Plants of the Lower Wabash. *Bot. Gazette*, 2: 83.
Feb. 1877.

Twenty-six plants added to his previous list.

— *Phacelia Covillei* at Mt. Carmel, Ill. *Bot. Gazette*, 27: 395-396.
May, 1899.

SHANNON, W. P. The Range of the Blue Ash, *Fraxinus Quadrangulata*. Proceedings of the Indiana Academy of Science, 1894,
pp. 107-108.

THOMAS, M. B. Collections of Plants Made During 1894. Proceedings of the Indiana Academy of Science, 1894, pp. 65-66.

THOMPSON, MAURICE. Geographical Botany. 15th Ann. Rept. Geol. Survey, 242-252. (1886.)

Introduction to paper by Coulter and Thompson.

— Preliminary Sketch of the Characteristic Plants of the Kankakee
Region. 16th Ann. Rept. Dept. of Geol. and Nat. Hist., 155-161.
(1889.)

Brief list of a few common plants.

— Geological and Natural History Report of Carroll County. 17th
Ann. Rept. Geol. Survey, 171-191. (1892.)

Contains a partial list of plants, pp. 188-190.

THOMPSON, HARVEY. Origin of the Flora of Indiana. *Bot. Gazette*,
11: 88-90. (April, 1886.)

Résumé of longer article, by Coulter and Thompson.

TROOP, J. Grasses of Indiana. *Bull. Ag. Exp. Sta.*, No 29. (Dec.
1889.)

Descriptions of 128 grasses known to inhabit Indiana, with figures of
several.

TROOP, J., and HADLEY, O. M. The American Persimmon. *Bull. Ag.
Exp. Sta.*, No. 60. (April, 1896.)

UNDERWOOD, LUCIEN M. Our Present Knowledge of the Distribution
of Pteridophytes in Indiana. Proceedings of the Indiana Academy
of Science, 1893, pp. 254-258.

VAN GORDER, W. B. Catalogue of the Flora of Noble County, Indiana,
pp. 52. Kendallville, Ind. (1885.)

List of 693 species, 25 of which are not in State Catalogue of 1881.

— Flora of Noble County, Indiana. 18th Ann. Rept. Geol. Sur-
vey, pp. 33-71. (1893.)

- WALKER, ERNEST.** Some Factors in the Distribution of *Gleditsia Triacanthos* and Other Trees. Proceedings of the Indiana Academy of Science, 1894, pp. 27-33.
- WILSON, GUY.** Flora of Hamilton and Marion Counties, Indiana. Proceedings of the Indiana Academy of Science, 1894, pp. 156-176.
- WRIGHT, JOHN S.** Botanical Products of the United States Pharmacopœia, 1890. Proceedings of the Indiana Academy of Science, 1894, pp. 108-119.
- Inarching of Oak Trees. Proceedings of the Indiana Academy of Science, 1897, pp. 171-172.
- Notes on the Cypress Swamps of Knox County. Proceedings of the Indiana Academy of Science, 1897, pp. 172-175.
- Notes on Certain Plants of Southwestern Indiana. Proceedings of the Indiana Academy of Science, 1892, pp. 41-42.
- YOUNG, A. HARVEY.** Manual of the Botany of Jefferson County. 2d Ann. Rept. Geol. Survey, 253-292. (1871)
List of 609 species.
- Notes on Certain Species of the Genus *Asplenium*. Bot. Bull., 1: 2-3. (Nov. 1875.)
Notes on four species of southern Indiana.
- Notes on Some Interesting Plants Found in Jefferson County. Bot. Bull., 1: 6-8. (Dec. 1875.)
Notes occurrence and stations of several rare plants.
- Notes on Some Gramineæ. Bot. Bull., 1: 18-20. (March, 1876.)
Notes based upon collections in Jefferson County.
- Ferns Near Hanover, Ind. Bot. Bull., 1: 22-23, 27. (April, May, 1876.)
Notes on habitat of twenty species of ferns.
- *Jeffersonia diphylla* Pers. Bot. Gazette, 2: 136-137. (Sept. 1877.)
Notes on variations.
- *Habenaria peramoena* Gray. Bot. Gazette, 2: 137. (Sept. 1877.)
Notes abundance near Hanover.
- *Monotropa uniflora*. Bot. Gazette, 3: 37-38. (April, 1878)
Notes station in Jefferson County, and poisonous effect; cf. Bot. Gazette, 3: 54-55 and 79, on latter point.

PLANTS REPORTED AS MEMBERS OF THE STATE FLORA, OMITTED
FROM THE PRESENT CATALOGUE.

The following plants, reported as occurring in the State by the authors of various local catalogues, have been omitted from the list. This has been done because of an inability to secure verifying specimens, and also, in almost every case, because of range improbabilities. Some of the plants omitted are from the far north, others are coast plants, still others are mountain forms. It is not asserted that they do not occur in the State, but that in view of the objections to their occurrence previously given, they must for the present be omitted :

DRYOPTERIS FILIX-MAS (L.) Schott. Male Fern.

(*Aspidium Filix-Mas* Sw.)

State Catalogue.

CHEILANTHES LANOSA (Michx.) Watt. Hairy-lip Fern.

Gibson.

EQUISETUM SYLVATICUM L. Wood Horse-tail.

Underwood.

POTAMOGETON CONFEROIDES Reichb. Alga-like Pondweed.

Hamilton (Wilson).

ZIZANIOPSIS MILIACEA (Michx.) Doell and Aschers Zizaniopsis.

Steuben (Bradner).

CINNA LATIFOLIA (Trev.) Griseb. Slender Wood Reed-grass.

(*C. pendula* Trin.)

Steuben (Bradner).

CAREX PRASINA Wahl. Drooping Sedge.

Steuben (Bradner).

CAREX EXILIS Dewey. Coast Sedge.

Steuben (Bradner).

PERAMIUM REPENS (L.) Salisb. Lesser Rattlesnake Plantain.

(*Goodyera repens* R. Br.)

Steuben (Bradner).

POPULUS BALSAMIFERA L. Tacamahac. Balsam Poplar.

Steuben (Bradner).

RUMEX OCCIDENTALIS S. Wats. Western Dock.

Jefferson (J. M. Coulter); Clark (Baird and Taylor).

RUMEX SANGUINEUS L. Bloody or Red-veined Dock.

Clark (Baird and Taylor); Jefferson.

- ATRIPLEX PATULA L.** Spreading Orache.
Steuben (Bradner).
- AMARANTHUS CRISPUS (Lesp. and Thev.) Braun.**
Putnam (MacDougal).
- AMARANTHUS PUMILUS Raf.** Coast Amaranth.
Union (MacDougal).
- ANEMONE PARVIFLORA Michx.** Northern Anemone.
Steuben (Bradner).
- RIBES LACUSTRE (Pers.) Poir.** Swamp Gooseberry.
St. Joseph (Rothert).
- GEUM RADIATUM Michx.** Yellow Mountain Avens.
Hamilton and Marion (Wilson).
- ROSA NITIDA Willd.** Northeastern Rose.
Wayne (Phinney).
- MALUS MALUS (L.) Britton.** Apple.
(*Pyrus Malus L.*)
Hamilton and Marion (Wilson).
- AMELANCHIER ALNIFOLIA Nutt.** Northwestern June or Service-berry.
Jefferson.
- GERANIUM ROBERTIANUM L.** Red Robin. Herb Robert.
Dearborn (Collins).
- OXALIS ACETOSELLA L.** White or True Wood-sorrel. Alleluia.
Dearborn (Collins); Laporte.
- SIDA HERMAPHRODITA (L.) Rusby.** Virginia Mallow.
(*S. Napæa Cav.*)
Steuben (Bradner).
- EPILOBIUM PALUSTRE L.** Marsh or Swamp Willow-herb.
Steuben (Bradner).
- AZALEA NUDIFLORA L.** Wild Honeysuckle. Pinkster-flower. Purple
or Pink Azalea.
Monroe.
- KALMIA ANGUSTIFOLIA L.** Sheep-laurel. Lambkill. Wicky.
Monroe.
- KALMIA LATIFOLIA L.** American or Mountain Laurel. Calico bush.
Monroe.
- OXYDENDRUM ARBOREUM (L.) D. C.** Sour-wood. Sorrel-tree.
Monroe.

- ANDROSACE OCCIDENTALIS** Pursh. **Androsace.**
Knox (Spillman).
- UTRICULARIA SUBULATA** L. **Tiny or Zigzag Bladderwort.**
Steuben (Bradner).
- GALIUM LATIFOLIUM** Michx. **Purple Bedstraw.**
Steuben (Bradner).
- VIBURNUM NUDUM** L. **Larger Withe-rod.**
Steuben (Bradner).
- NABALUS SERPENTARIUS** (Pursh). Hook. **Lion's-foot. Gall-of-the-Earth.**
(*Prenanthes serpentaria* Pursh.)
Steuben (Bradner).
- COLEOSANTHUS GRANDIFLORUS** (Hook) Kuntze. **Large-flowered Thor-
oughwort.**
Hamilton (Wilson).
- ASTER TENUIFOLIUS** L. **Perennial Saltmarsh Aster.**
Steuben (Bradner).
- GNAPHALIUM DECURRENS** Ives. **Clammy Everlasting. Winged Cudweed.**
Steuben (Bradner).
- TANACETUM VULGARE CRISPUM** D. C.
State Catalogue.

LIST OF FERNS, FERN ALLIES AND FLOWERING
PLANTS OCCURRING IN INDIANA.

PTERIDOPHYTA.

FERNS AND FERN ALLIES.

OPHIOGLOSSACEÆ. Adder's-tongue Family.

OPHIOGLOSSUM L.

O. VULGATUM L. Adder's-tongue.

Reported from a few southern counties, in moist meadows and thickets, or sometimes on dry hillsides.

Jefferson, Crawford, Gibson and Monroe.

BOTRYCHIUM Sw.

B. TERNATUM (Thurb.) Sw. Ternate Grape-fern.

Found throughout the State in moist meadows, woods, and on hillsides.

Fayette (Hessler); Vigo (Blatchley); Hamilton (Wilson); Steuben (Bradner); Gibson, Jefferson, and Lake.

B. VIRGINIANUM (L.) Sw. Virginia Grape-fern.

Frequent throughout the State in rich open woods.

Kosciusko (Chipman); Knox (Spillman); Vigo (Blatchley); Hamilton (Wilson); Steuben (Bradner); Gibson, Jefferson, and Lake.

OSMUNDACEÆ. Royal Fern Family.

OSMUNDA L.

O. REGALIS L. Royal Fern.

Rare throughout the State in low wet woods and marshes.

Knox (Spillman); Vigo (Blatchley); Hamilton (Wilson); Steuben (Bradner); Noble, Jefferson, and Floyd.

- O. CINNAMONEA L. Cinnamon Fern.
 Found throughout the State in wet places.
 Vigo (Blatchley); Steuben (Bradner); Jefferson and Montgomery.
- O. CLAYTONIA L. Clayton's Fern.
 Reported from several counties, in swamps and on shaded banks.
 Vigo (Blatchley); Gibson.

POLYPODIACEÆ. Fern Family.

ONOCLEA. L.

- O. SENSIBILIS L. Sensitive Fern.
 Frequent in dense, moist woods.
 Monroe and Vigo (Blatchley); Hamilton and Marion.
- O. STRUTHIOPTERIS (L.) Hoffm. Ostrich Fern.
 Occurs in moist thickets, especially along streams.
 Montgomery.

WOODSIA R. Br.

- W. OBTUSA (Spreng) Torr. Blunt-lobed Woodsia.
 Jefferson and Gibson.

DICKSONIA L'Her.

- D. PUNCTILOBULA (Michx.) Gray. Hay-scented Fern.
 (*D. pilosiuscula* Willd.)
 Found throughout the State in various situations, most abundant
 on open hillsides.
 Steuben (Bradner); Clark, Floyd, and Gibson.

CYSTOPTERIS Bernh.

- C. BULBIFERA (L.) Bernh. Bulbet Cystopteris.
 Found on wet rocks and in ravines, especially on limestone.
 Monroe, Crawford and Vigo (Blatchley); Marion (Wilson);
 Jefferson, and Tippecanoe.
- C. FRAGILIS (L.) Bernh. Brittle Fern.
 In moist grassy woods and on rocks. Scarce.
 Vigo (Blatchley); Hamilton (Wilson).

DRYOPTERIS Adans.

D. ACROSTICHOIDES (Michx.) Kuntze. Christmas Fern.

(Aspidium acrostichoides Sw.)

Common throughout the State, in woods and on sides of ravines, in rich soil.

Knox (Spillman); Vigo (Blatchley); Steuben (Bradner); Hamilton and Marion (Wilson).

D. NOVEBORACENSIS (L.) Gray. New York Fern.

(Aspidium Noveboracense Sw.)

Found in moist woods and thickets.

D. THELYPTERIS (L.) Gray. Marsh Shield-fern.

(Aspidium Thelypteris Sw.)

Abundant throughout the State in low wet meadows and prairies, rarely in dry soil.

Shriner Lake (Deam); Vigo (Blatchley); Hamilton (Wilson).

D. GOLDIEANA (Hook) Gray. Goldie's Fern.

(Aspidium Goldieanum Hook.)

Found in deep gorges leading into the principal streams.

D. MARGINALIS (L.) Gray. Evergreen Wood-fern.

(Aspidium marginale Sw.)

Found on the sides of ravines, in rocky woods and on banks. Putnam and Vigo (Blatchley).

D. SPINULOSA INTERMEDIA (Muhl.) Underw.

(Aspidium spinulosam intermedium D. C. Eaton.)

Common in moist, dense woods.

Monroe and Vigo (Blatchley); Hamilton (Wilson); Putnam (Hubbard).

PHEGOPTERIS Fée.

P. PHEGOPTERIS (L.) Underw. Long Beech-fern.

In moist woods and on hillsides.

Putnam (Underwood).

P. HEXAGONOPTERA (Michx.) Fée. Broad Beech-fern.

Common on wooded hillsides in moist rich soil.

Monroe and Vigo (Blatchley); Hamilton and Marion (Wilson).

- P. DRYOPIERIS (L.) Fée.** Oak-fern.
In moist woods, thickets, and swamps.
Allen (Sanford).

WOODWARDIA J. E. Smith.

- W. VIRGINICA (L.) J. E. Smith.** Virginia Chain-fern.
Occurs in swamps in the northern counties.
Lake and Laporte.

CAMPTOSORUS Link.

- C. RHIZOPHYLLUS (L.) Link.** Walking Fern.
Abundant in southern counties on dry rocks, preferring limestone.
Knox (Spillman); Jefferson; Clark; Crawford.

ASPLENIUM L.

- A. PINNATIFIDUM** Nutt. Pinnatifid Spleenwort.
Occurs on rocks.
Gibson.
- A. EBENOIDES** R. R. Scott. Scott's Spleenwort.
Occurs on limestone rocks.
Jefferson (J. M. Coulter); Crawford (Blatchley).
- A. PLATYNEURON (L.) Oakes.** Ebony Spleenwort.
(*A. ebeneum* Ait.)
On sides of ravines and damp wooded slopes, preferring limestone soils.
Vigo (Blatchley); Steuben (Bradner).
- A. TRICHOMANES** L. Maiden-hair Spleenwort.
Occurs on rocks, preferring limestone.
Gibson.
- A. ANGUSTIFOLIUM** Michx. Narrow-leaved Spleenwort.
Common in central and southern part of State on sides of ravines.
Vigo (Blatchley); Hamilton (Wilson); Tippecanoe.
- A. RUTA-MURARIA** L. Wall Rue Spleenwort.
Occurs abundantly in southern part of the State.
Jefferson, Clark, and Floyd.

- A. ACROSTICHOIDES Sw. Silvery Spleenwort.
 (*A. thelypteroides* Michx.)
 Hamilton (Wilson); Vigo (Blatchley); Steuben (Bradner).

- A. FILIX-FOEMINA (L.) Bernh. Lady-fern.
 Occurs in woods, thickets, and by walls and fences.

ADIANTUM L.

- A. PEDATUM L. Maiden-hair Fern.
 Occurs throughout the State in moist hillside thickets and woods.
 Decatur and Shelby (Ballard); Vigo (Blatchley); Hamilton and
 Marion (Wilson); Steuben (Bradner).

PTERIS L.

- P. AQUILINA L. Brake.
 Throughout the State in open places along fence-rows and edge of
 thickets.

PELLÆA Link.

- P. ATROPURPUREA (L.) Link. Purple-stemmed Cliff-brake.
 Occurs on rocks, preferring limestone.

CHEILANTHES Sw.

- C. LANOSA (Michx.) Watt. Hairy Lip-fern.
 (*C. lanuginosa* Nutt.)
 Occurs on rocks.
 Gibson.

POLYPODIUM L.

- P. VULGARE L. Common Polypody.
 Occurs on rocks or on rocky banks.
 Steuben (Bradner); Montgomery and Parke.
- P. POLYPODIOIDES (L.) A. S. Hitchcock. Gray Polypody.
 Occurs in southern part of the State on trees or rarely on rocks.
 Clark, Floyd, Perry, Gibson, Posey, and Jefferson.

SALVINIACEÆ. *Salvinia* Family.

AZOLLA Lam.

- A. CAROLINIANA Willd. Carolina Azolla.
 Floating on still water.

EQUISETACEÆ. Horsetail Family.

EQUISETUM.

E. ARVENSE L. Field Horsetail.

Occurs commonly, throughout the State on moist, sandy or gravelly banks.

Vigo (Blatchley); Hamilton and Marien (Wilson); Steuben (Bradner); Gibson.

E. FLUVIATILE L. Swamp Horsetail.

Occurs on the margins of ponds or in shallow water.

Vigo (Blatchley); Lake (Hill).

E. ROBUSTUM A. Br. Stout Scouring-rush.

Occurs in counties along the Ohio river.

E. HYEMALE L. Common Scouring-rush.

Occurs in wet soil, along railways, rivers, and old canals.

Vigo (Blatchley); Hamilton (Wilson); Steuben (Bradner).

E. LAEVIGATUM A. Br. Smooth Scouring-rush.

Along streams and rivers, especially in clay soils.

Lake (Hill).

E. VARIEGATUM Schleich. Variegated Equisetum.

This species has been reported from Lake County by Rev. E.J. Hill.

LYCOPODIACEÆ. Club-moss Family.

LYCOPODIUM L.

L. LUCIDULUM Michx. Shining Club-moss.

Occurs in cold, damp woods.

Putnam (Underwood); Steuben (Bradner).

L. INUNDATUM L. Bog Club-moss.

Occurs in sandy bogs in northern counties.

Steuben (Bradner); Lake (Hill).

L. OBSCURUM L. Ground Pine.

In moist woods.

Lake and Montgomery.

- L. COMPLANATUM L. Trailing Christmas-green.
 In woods and thickets.
 Lake, Laporte, Putnam, and Monroe.

SELAGINELLACEÆ.

SELAGINELLA Beauv.

- S. RUPESTRIS (L.) Spring. Rock Selaginella.
 Occurs on dry rocks.
 Lake (Hill); Gibson, and Montgomery.
- S. APUS (L.) Spring. Creeping Selaginella.
 In moist shaded places, often among the grass.
 Gibson, Jefferson, and Tippecanoe.

SPERMATOPHYTA.

SEED-BEARING PLANTS.

Class 1.

GYMNOSPERMÆ.

PINACEÆ. Pine Family.

PINUS L.

- P. STROBUS L. White Pine.

Reported from a few counties in the southern, and a few in the northern, part of the State, also found in various hill regions through the central counties. The tree in this State does not reach its full development, and is much less valuable than farther north. Its scant distribution gives it no local value, although it is the most common and valuable building material of the northern States, and is used for an almost infinite variety of other purposes.

- P. DIVARICATA (Ait.) Sudw. Gray or Northern Scrub Pine.
 (*P. Banksiana* Lamb.)

In the central and northern part of the State, occurring in scant numbers. A small tree from thirty to sixty feet high and rarely exceeding two and one-half feet in diameter. Too local to be of economic value.

Lake (Hill); Putnam (MacDougal).

P. ECHINATA Mill. Yellow Pine. Spruce Pine.

(P. mitis Michx.)

Found in the southern counties. This tree does not reach its full development in this State, in many regions being but little more than a shrub. In its full development it reaches a height of 100 feet, with a diameter of from 3 to 4½ feet. It is largely manufactured into lumber, and is the most valuable of the yellow pines.

LARIX Adans.

L. LARICINA (Du Roi) Koch. Black Larch. Tamarack.

(L. Americana Michx.)

Found only in northern counties, where it is fairly abundant in wet soils, being the character tree of the so-called "tamarack swamps." The species is rapidly disappearing as the result of drainage. A tree from eighty to one hundred feet high with a diameter of from two to three feet. Wood heavy, hard, very strong and durable in contact with the soil. Used for posts, telegraph poles and railway ties.

TSUGA Carr.

T. CANADENSIS (L.) Carr. Hemlock.*

This species occurs in Putnam County in a single location of considerable extent. I quote from a letter of Mr. W. H. Ragan, who sent at the same time abundant specimens: "In the northeast portion of this (Putnam) county, Jackson Township, on the sandstone bluffs of Walnut Creek, in and along its deep and tortuous canyon, the hemlock spruce has existed in its native beauty from a time long anterior to the present historic period. The general course of Walnut Creek through Jackson Township is southwesterly, and its canyon is deep (for this comparatively level country) and tortuous. The upper geological formation is a shelly limestone, that rests upon a light blue or gray sandstone, through which the stream has worn its way to a depth of fifty or sixty feet, forming almost perpendicular bluffs, first on one side of the creek and then on the other. On these bluffs and extending back over small portions of the adjacent level lands and intermingling with our more common forest trees a hemlock grove, now largely cut away for its timber and its bark and to make way for the plow and other implements of the farmer, was discovered by the pioneer settlers who located in this region in the early years of the third decade of this century. This isolated grove occupied its limited area in the midst of the giant forest of deciduous

*The hemlock occurs also in Russell Township, Putnam County, on the banks of Raccoon Creek, two miles northeast of Portland Mills.—W. S. B.

timber that originally prevailed throughout the central portion of our State. Its latitude is about $39^{\circ} 45'$, and its longitude $86^{\circ} 50'$, while it is elevated about 1,000 feet above the sea. In extent it is about seven or eight miles in length, following the meanderings of the creek, and according to my observations, which are confirmed by the testimony of others, is wholly confined to the east or left bank of the stream. An additional feature of interest is that among these semioxotic groves may be found another conifer, elsewhere unknown in the flora of this immediate section, the American Yew, *Taxus baccata*, where it trails over the rocks and luxuriates in the deep cool shade of its more majestic foster relative."

TAXODIUM L. C. Rich.

T. DISTICHUM (L.) L. C. Rich. Bald Cypress.

Found only in the southwestern counties, where the so-called cypress swamps cover an area of nearly 20,000 acres. A large tree of high economic value, from 80 to 100 feet high, with a trunk from six to thirteen feet in diameter, growing in deep, submerged swamps and river bottoms, often forming dense forests. Wood light, soft, straight grained; easily worked and extremely durable in contact with the soil, but not strong. Manufactured into lumber, and used for construction, cooperage, railway ties, posts, fencing, etc. The recklessly extravagant use of this valuable tree is rapidly reducing its available area. Especially valued for the durable shingles made from it. A cypress roof is good for 20 or more years. (Schneck)

THUJA L.

T. OCCIDENTALIS L. Arbor-Vitæ. White Cedar.

Found only in the northern counties, and not occurring there in any marked abundance. A tree 40 to 60 feet high, with a diameter at times from three to five feet, growing in cold, wet swamps and along rocky creek banks. The wood is light, soft and brittle, but being durable in contact with the soil, it is largely used for posts, railway ties, fencing, and to a less extent for shingles. Largely cultivated as a hedge plant.

CHAMÆCYPARIS Spach.

C. THYOIDES (L.) B. S. P. Southern White Cedar. Cypress.

(*C. sphaeroidea* Spach.)

A few specimens of this conifer are to be found in Allen County, upon the authority of Dr. C. R. Dryer. Its occurrence in our area must be considered as exceptional.

JUNIPERUS L.

J. COMMUNIS L. Juniper.

Found in dry, sandy soils in a few counties, usually growing on hillsides. Nowhere abundant.

Vigo (Blatchley); Steuben (Bradner).

J. NANA Willd. Low Juniper.

Found very sparingly in the central and northern counties in dry, sandy soil in upland situations.

Flowers in May.

Hamilton (Wilson); Kosciusko, Lake, Porter, Steuben, and Lagrange.

J. VIRGINIANA L. Red Cedar.

Found throughout the State, being especially abundant in the hill regions of the southern counties, lessening in number and decreasing in size in the central counties, and increasing again in both numbers and size in the northern counties. A tree from 75 to 100 feet high and with a trunk diameter of from two to four feet, a size not reached in the State to my knowledge. It thrives best on dry, gravelly ridges and limestone hills. The odorous wood is light and soft and easily worked, and is durable in contact with the soil. Used for posts, sills, railway ties, cabinet making, and almost exclusively for lead pencils.

TAXACEÆ. Yew Family.

TAXUS L.

T. MINOR (Michx.) Britton. American Yew. Ground Hemlock.
(*T. Canadensis* Willd.)

Found only in Putnam County, associated with *Tsuga Canadensis*. The occurrence of both of these species in our area is exceedingly difficult of explanation, their range being far to the north.

Class 2.

ANGIOSPERMÆ.

Sub-class 1.

MONOCOTYLEDONES.

TYPHACEÆ. Cat-tail Family.

TYPHA L.

T. LATIFOLIA L. Broad leaved Cat-tail.

In all parts of the State in marshes; very abundant, frequently exclusively occupying large areas.

Flowers in June and July; fruits in August and September.

Tippecanoe (Cunningham); Laporte (Barnes); Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Round Lake (Deam); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

T. ANGUSTIFOLIA L. Narrow-leaved Cat-tail.

Reported from a few of the northern counties and verified by herbarium specimens. Of very occasional occurrence.

Flowers in June and July; fruits in August and September.
Steuben (Bradner).

SPARGANIACEÆ. Bur-reed Family.

SPARGANIUM L.

S. EURYCARPUM Engelm.

In many counties of the State in swamps and along the borders of ponds and streams. As a rule of no great abundance in its stations.

Flowers in May, continuing through August.

Vermillion (Wright); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

S. ANDROCLADUM (Engelm.) Morong. Branching Bur-reed.

(*S. simplex androcladum* Engelm.)

Reported only from the southwestern counties and growing rather plentifully locally, in the shallow waters of ponds and swamps.

Flowers from June through August.

Gibson.

S. SIMPLEX Huds.

In the central and northern parts of the State, in ponds and on the borders of streams. Exceptionally found.

Flowers in July and August.

Hamilton (Wilson); Fayette (Hessler).

S. MINIMUM Fries. Small Bur-reed.

Reported only from the northern part of the State, where it is found sparingly in ponds and sluggish streams.

Flowers in June and July.

Lake (Hill).

NAIADACEÆ. Pondweed Family.

POTAMOGETON L.

- P. NATANS L.** Common Floating Pondweed.
 Throughout the State in ponds, the shallow waters of lakes and in sluggish streams.
 Flowers in July and August.
 Vigo (Blatchley); Steuben (Bradner).
- P. AMPLIFOLIUS** Tuckerm. Large-leaved Pondweed.
 Reported only from northern counties as growing in the inland lakes in quiet bays.
 Flowers from July until in September.
 Lake (Hill); Hamilton (Wilson).
- P. PULCHER** Tuckerm. Spotted Pondweed.
 Northern counties, in ponds and pools about lakes. Detected as a member of the State flora by E. J. Hill.
 Flowers in July.
 Lake (Hill).
- P. NUTTALLII** Cham. and Sch.
(P. Pennsylvanicus Cham.)
 In ponds and streams throughout the State, apparently more abundant in the southern counties.
 Flowers in June and July.
 Steuben (Bradner); Gibson.
- P. LONCHITES** Tuckerm. Long-leaved Pondweed.
 Throughout the State in ponds and sluggish streams. Plentiful in the stations from which it is reported.
 Flowers from July through September.
 Gibson (Schneck); Lake (Hill).
- P. HETEROPHYLLUS** Schreb.
 Reported only from the extreme northern and southern counties, but doubtless occurring in all parts of the State. A very variable and puzzling species.
 Flowers from July until September.
 Steuben (Bradner); Lake (Hill).

P. ZIZII Roth.

In ponds and sluggish streams in the northern counties of the State. Of sparing occurrence in its stations.

Flowers in July and August.

Lake (Hill).

P. LUCENS L. Shining Pondweed.

Found locally in ponds and swamps in a few counties of the State.

Flowers in September and October.

Steuben (Bradner); Gibson.

P. PRÆLONGUS Wulf. White-stemmed Pondweed.

Reported only from the northern part of the State by E. J. Hill, though probably of wider distribution.

It fruits in June and July and usually withdraws its stems beneath the water as soon as the fruit is set.

Lake (Hill).

P. PERFOLIATUS RICHARDSONII A. Bennett.

(*P. perfoliatus lanceolatus* Robbins.)

In the northern counties in ponds and streams. Probably of wider distribution than reports indicate.

Flowers in July and August.

Laporte (Hill).

P. ZOSTEREFOLIUS Schum. Eel-grass Pondweed.

Common throughout the State, usually in still water, though occasionally found in quite swift streams.

Flowers in July and August.

Laporte (Barnes); Steuben (Bradner); Lake (Hill); Carroll.

P. FOLIOSUS Raf.

(*P. pauciflorus* Pursh.)

Throughout the State, in shallow ponds and ditches. Usually abundant in the stations in which it occurs.

Flowers in July and August.

Jasper (J. M. Coulter); Hamilton (Wilson); Fayette (Hessler); Vigo (Blatchley); Jefferson and Gibson.

P. FOLIOSUS NIAGARENSIS (Tuckerm.) Morong.

(*P. pauciflorus Niagarensis* Gray.)

A larger form than the preceding, found in similar situations. Reported from the northern counties.

Flowers in July and August.

Laporte.

- P. PUSILLUS L.** Small Pondweed.
 In sluggish streams and shallow waters throughout the State.
 Not abundant in any of its stations.
 Flowers in July and August.
 Gibson (Schneck).
- P. DIVERSIFOLIUS Raf.**
 (*P. hybridus* Michx.)
 In many parts of the State in ponds and swamps. Quite abundant in the stations in which it occurs.
 Flowers from June until September.
 Vigo (Blatchley); Lake and Laporte (Hill).
- P. SPIRILLUS Tuckerm.**
 Reported from the southern part of the State, but doubtless to be found throughout our area in ponds and sluggish waterways.
 Flowers from June until August.
 Vigo (Blatchley).
- P. PECTINATUS L.** Fennel-leaved Pondweed.
 Found in the Wabash River in various parts of its course, more plentifully in its lower stretches.
 Flowers in July and August.
- P. INTERRUPTUS Kitaibel.**
 In the northern part of the State in shallow, still or sluggish waters.
 Flowers in July and August.
 Lake (Hill).
- P. ROBBINSII Oakes.**
 In the northern part of the State in shallow waters of lakes and in swamps. Added to the flora by Rev. E. J. Hill.
 Flowers in August and September.
 Lake (Hill); Steuben (Bradner).

ZANNICHELLIA L.

- Z. PALUSTRIS L.**
 Collected from a single locality near Terre Haute. The station was a pond south of a blast furnace. The pond rarely froze on account of the warm stream of water flowing into it from the furnace. Detected first in 1886 and its continuance noted until 1893. At

that time the furnace shut down, the pond soon after drying up. The plant is probably no longer a member of our flora.

Flowers from July through September. In the station mentioned specimens in fruit were collected in April.

Vigo (Coulter).

NAIAS L.

N. FLEXILIS (Willd.) Rost. and Schmidt.

In the lower Wabash and in the pools and swamps adjoining. Not uncommon, but nowhere abundant.

Flowers in June and July.

N. GRACILLIMA (A. Br.) Morong.

(*N. Indica gracillima* A. Br.)

In pools and shallow, still waters in the southwestern counties. The species occurs sparingly in a few stations and has been rarely collected.

Flowers in July and August.

Gibson (Schneck).

SCHEUCHZERIACEÆ. Arrow-grass Family.

TRIGLOCHIN L.

T. PALUSTRIS L. Marsh Arrow-grass.

In bogs and swamps in the northern part of the State. It probably does not extend southward in the State to any great extent.

Flowers in July and August.

Lake (Hill).

T. MARITIMA L. Seaside Arrow-grass.

Found in marshes and cold bogs in the northern counties. Recognized as a member of the State flora by E. J. Hill.

Flowers in July and August.

Lake (Hill).

SCHEUCHZERIA L.

S. PALUSTRIS L.

In the central and northern counties in marshes and bogs. Especially abundant in cold peat bogs.

Flowers from June through August.

Cass and Marshall (Hessler).

ALISMACEÆ. Water Plantain Family.

ALISMA L.

A. PLANTAGO-AQUATICA L. Water Plantain.

(A. Plantago L.)

Found throughout the State in shallow waters and in mud, usually very plentiful in the stations in which it occurs.

Flowers from June until September.

Tippecanoe (Cunningham); Laporte (Barnes); Putnam (MacDougal); Fayette (Heesler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner); Kosciusko (Coulter).

ECHINODORUS Rich.

E. CORDIFOLIUS (L.) Griseb. Upright Bur-head.

(E. rostratus Engelm.)

Reported only from the southern part of the State and probably not extending far northward, as the species is southern in its mass distribution. It was first reported by W. S. Blatchley in 1889, as growing abundantly in mud flats on the borders of a pond.

Flowers in June and July.

Vigo (Blatchley).

SAGITTARIA L.

S. ENGELMANNIANA J. G. Smith.

(S. variabilis gracilis Engelm.)

Common, especially in the central part of the State in shallow water and along the wet shores of sluggish streams.

Flowers in August and September.

Putnam (MacDougal); Fayette (Heesler); Hamilton (Wilson); Decatur (Ballard).

S. LATIFOLIA Willd. Broad-leaved Arrow-head.

(S. variabilis Engelm.)

Common in the shallow waters of ponds and ditches, extending often far out on low muddy banks.

Flowers in July and August.

Tippecanoe (Cunningham); Daviess (Clements); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

S. LATIFOLIA PUBESCENS (Muhl.) J. G. Smith.

(S. variabilis pubescens Engelm.)

In similar situations as the preceding, but less common and less widely distributed.

Flowers in July and August.

Hamilton and Marion (Wilson).

S. RIGIDA Pursh.*(S. heterophylla* Pursh.)

Throughout the State in swamps and shallow water. Varies greatly in appearance in different situations. When growing in running water the petioles become rigid.

Flowers from late in May through August.

Round Lake (Deam); Vigo (Blatchley).

S. GRAMINEA Michx. Grass-leaved Arrow-head.

Throughout the State, growing in mud or shallow water. Abundant in all stations from which it is reported. "The early leaves are often purplish." (Britton and Brown).

Flowers from July through September.

Tippecanoe (Cunningham); Laporte (Barnes); Kosciusko (Coulter).

VALLISNERIACEÆ. Tape-grass Family.

PHILOTRIA Raf.

P. CANADENSIS (Michx.) Britton. Water-weed. Ditch-moss.*(Elodea Canadensis* Michx.)

Abundantly found in ponds and shallow waters in all parts of the State. Extremely variable in our area.

Flowers from May until August.

Laporte (Barnes); Noble (Van Gorder); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Putnam (MacDougal); Vigo (Blatchley); Steuben (Bradner); Kosciusko and Tippecanoe (Coulter).

VALLISNERIA L.

V. SPIRALIS L. Tape-grass. Eel-grass.

Throughout the State in quiet waters of swamps and lakes. Quite common in most of its stations. "The wild celery of Chesapeake Bay and a favorite food of the canvas-back duck" (Britton and Brown).

Flowers in August and September.

Jefferson (J. M. Coulter); Clark (Baird and Taylor); St. Joseph (Barnes); Vigo (Blatchley); Steuben (Bradner).

GRAMINEÆ. Grass Family.

ANDROPOGON L.

A. SCOPARIUS Michx. Brown Beard-grass.

Common, especially northward, growing in dry, rather sandy soil. Flowers from July to September.

Elkhart (Barnes); Vigo (Blatchley); Steuben (Bradner).

A. FURCATUS Muhl. Forked Beard-grass:

A common form on prairie soil, either moist or dry, where it furnishes a large amount of hay.

Flowers in August and September.

Jefferson (Barnes); Vigo (Blatchley); Steuben (Bradner).

A. VIRGINICUS L.

Common especially southward, growing on sandy and gravelly banks, in either dry or damp soils.

Flowers in September and October.

Vigo (Blatchley).

CHRYSOPOGON Trin.

C. AVENACEUS (Michx.) Benth. Indian Grass.

(*C. nutans* Benth.)

Rather common in sandy, waste places and on hillsides in dry situations. Growing ordinarily rather sparsely.

Flowers from August until in October.

Tippecanoe (Cunningham); Jefferson (Barnes); Vigo (Blatchley); Marion (Moffatt).

SORGHUM Pers.

S. HALAPENSE (L.) Pers. Johnson Grass.

"This was introduced, and is occasionally found escaped from cultivation; it is considered valuable farther south and on the dry lands farther west, but its good qualities have not yet been determined here. It is very late in starting in the spring, but holds on well into the autumn, and for that reason might be valuable as furnishing fall feed." (J. Troop, Grasses of Indiana, p. 42.)

Flowers September and October.

PASPALUM L.

-P. MUCRONATUM Muhl.

(*P. fluitans* Kunth.)

A southern form which is found in wet soils along streams and in swamps in the southern counties of the State.

Flowers in September.

P. SETACEUM Michx. Slender Paspalum.

Common in dry, sandy soil in open places throughout the State. Stem mostly *decumbent*.

Flowers in August and September.

Jefferson (Barnes); Vigo (Blatchley).

P. CILIATIFOLIUM Michx. Ciliate-leaved Paspalum.

Common in waste places in dry, sandy soil in the southern part of the State.

Flowers from June until late in August.

Vigo (Blatchley).

P. LAEVE Michx. Field Paspalum.

"Very common in wet land, especially in the southern part of the State, where it is said to produce large crops of hay." (J. Troop, Grasses of Indiana, p. 38).

Flowers in August and September.

SYNTHERISMA Walt.

S. SANGUINALIS (L.) Nash. Crab grass. Finger-grass.

(*Panicum sanguinale* L.)

Throughout the State in cultivated or waste places. In our area it is considered a troublesome weed, but farther south is reported to make valuable hay.

Flowers in August and October.

Tippecanoe (Cunningham); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

S. LINEARIS (Krock.) Nash. Small Crab grass.

(*Panicum glabrum* Gaud.)

Introduced in our area. A small, spreading form, common in lawns late in the season, where it becomes a great nuisance. (Troop, Grasses of Indiana, p. 38.)

Flowers in August and September.

Jefferson.

S. FILIFORMIS (L.) Nash. Slender Finger-grass.

(*Panicum filiforme* L.)

Commonly found throughout the State on dry, sandy soil.

Flowering season, August and September.

PANICUM L.

P. CRUS-GALLI L. Barn-yard Grass.

A coarse, branching grass from one to four feet high, found in rich, moist, waste places throughout the State. Especially abundant about neglected barn-yards.

Flowers from August through October.

Tippecanoe (Cunningham); Round Lake (Deam); Vigo (Blatchley); Hamilton and Marion (Wilson); Jefferson and Gibson; Steuben (Bradner).

P. WALTERI Pursh. Salt-marsh Cockspur Grass.

Somewhat common in moist soils, especially in the southern part of the State.

Flowers in July and August.

Daviess (Clements).

P. ROSTRATUM Muhl. Beaked Panicum.

(*P. anceps* Michx.)

Found in moist soils throughout the State. More abundant in the central and northern counties, though found also in the southern. Resembles the species next following, but does not make such valuable hay.

Flowers in July and August.

Jefferson and Gibson.

P. AGROSTIDIFORME Lam.

(*P. agrostoides* Muhl.)

Abundant in wet grounds and along streams in the southern counties. "It makes a large amount of foliage, which makes good hay if cut before flowering." (Troop.)

Flowers in July and August.

Steuben (Bradner.)

P. MICROCARPON Muhl. Small-fruited Panicum.

In the southern counties in shaded places, in rather dry soil. Somewhat abundant in its stations.

Flowers in July and August.

Daviess (Clements).

P. PORTERIANUM Nash.

(*P. latifolium* Walt.)

In thickets and open woods in the southern counties. Quite common, especially in rich, moist soils.

Flowers in June and July.

Vigo (Blatchley).

P. CLANDESTINUM L. Hispid Panicum.

A coarse, broad-leaved species, growing in wet meadows on the edge of thickets. Usually found in rich soils.

Flowers in June and July.

Cass (Hessler); Vigo (Blatchley); Steuben (Bradner).

- P. SCRIBNERIANUM** Nash. Scribner's Panicum.
 In the northern part of the State, in dry, sandy soil. Not abundant.
 Flowers in July and August.
 Lake (Hill).
- P. DICHOTOMUM** L. Forked Panicum.
 A very common and variable species, found in dry ground, usually in shaded places. Of no great value as a forage plant.
 Flowers in July and August.
 Tippecanoe (Cunningham); Vigo (Blatchley); Steuben (Bradner).
- P. VISCIDUM** Ell. Velvety Panicum.
 In the southern counties of the State, in moist places. (Troop.)
 Not abundant.
 Flowers in July and August.
- P. PUBESCENS** Lam. Hairy Panicum.
 Common in many parts of the State, in dry soils. Most abundant along railway embankments.
 Flowers in June and July.
 Vigo (Blatchley).
- P. DEPAUPERATUM** Muhl. Starved Panicum.
 Common throughout the State, growing in dry woods. (Troop.)
 Flowers from June until September.
- P. VIRGATUM** L. Tall Panic-grass.
 A tall, perennial grass, from three to five feet high, growing in clumps along sandy river banks. "A very prolific species which makes good hay if cut when young, but which is too harsh and woody when ripe." (Troop) Common throughout the State.
 Flowers in August and September.
 Vigo (Blatchley); Marion (Moffatt); Jasper.
- P. AMARUM** Ell. Sea-beach Panicum.
 I have not seen this species. It is admitted to the flora of the State upon the authority of Professor W. S. Blatchley, who reports it as occurring in Vigo County. The form is a sea beach form, and its occurrence in our bounds must be regarded as very exceptional.
- P. PROLIFERUM** Lam. Spreading Panicum.
 Found in marshy places, especially in wet sandy or gravelly soils, in the southern counties. Usually abundant.
 Flowers in July and August.
 Vigo (Blatchley); Marion (Moffatt).

P. CAPILLARE L. Witch Grass Tumble weed.

Commonly found throughout the State in sandy soil and as a weed in cultivated fields.

Flowers in August and September.

Tippecanoe (Cunningham); Jefferson (Barnes); Round Lake (Deam); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

P. AUTUMNALE Bosc. Diffuse Panicum.

Found in the southwestern counties on sandy hillsides and banks and along railways. Common in its stations.

Flowers in September and October.

Vigo (Blatchley).

P. MINUS (Muhl.) Nash.

Common in dry soil in shaded places, in the southwestern counties of the State. Especially abundant upon hillsides.

Flowers in August and September.

Vigo (Blatchley).

IXOPHORUS Schlecht.

I. VERTICILLATUS (L.) Nash. Foxtail-grass.

(*Setaria verticillata* Beauv.)

In waste places about dwellings. Reported only from Marion County.

Flowers in July and August.

I. GLAUCUS (L.) Nash. Yellow Foxtail. Pigeon-grass.

(*Setaria glauca* Beauv.)

Found everywhere in cultivated fields and waste places. Very frequently a troublesome weed.

Flowers from July through September.

Vigo (Blatchley); Hamilton and Marion (Wilson); Tippecanoe (Cunningham); Steuben (Bradner).

I. VIRIDIS (L.) Nash. Green Foxtail-grass.

(*Setaria viridis* Beauv.)

A very troublesome weed in gardens and cornfields. Common throughout the State.

Flowers from July until in September.

Tippecanoe (Husey); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

I. ITALICUS (L.) Nash. Hungarian Grass. Italian Millet.

(Setaria Italica Kunth.)

Escaped from cultivation in the southern part of the State. Found in waste places adjoining cultivated areas, or in abandoned fields.

Flowers from June through August.

Vigo (Blatchley); Jefferson and Gibson; Steuben (Bradner).

CENCHRUS L.

C. TRIBULOIDES L. Bur-grass. Hedgehog-grass.

Found in dry, sandy soils in all parts of the State. The heads are covered with sharp, stout spines and are extremely distressing to stock. A noxious weed in many parts of the State.

Flowers in August and September.

Daviess (Clements); Clark (Barnes); Hamilton and Marion (Wilson); Vigo (Blatchley).

ZIZANIA L.

Z. AQUATICA L. Wild Rice. Water Oats.

In shallow water, near the margins of ponds and lakes, and in adjacent low grounds. Sometimes covering areas of many acres. Especially common in the northern part of the State.

Flowers from June through September.

Laporte (Barnes); Hamilton (Wilson); Round Lake (Deam); Vigo (Blatchley); Marshall and Kosciusko (Coulter); Gibson; Steuben (Bradner).

HOMALOCENCHRUS Mieg.

H. VIRGINICUS (Willd.) Britton. White Grass.

(Leersia Virginica Willd.)

Common in the southwestern part of the State in damp woods and moist shaded places.

Flowers in August and September.

Vigo (Blatchley); Marion; Steuben (Bradner).

H. ORYZOIDES (L.) Poll. Rice Cut-grass.

(Leersia oryzoides Swartz.)

Common in swamps and along streams, often forming dense, tangled masses.

Flowers in August and September.

Tippecanoe (Cunningham); Cedar Lake (Deam); Vigo (Blatchley); Steuben (Bradner).

H. LENTICULARIS Michx. Scribn. Catch-fly Grass.*(Loesia lenticularis Michx.*

Margins of ponds and in low, wet grounds in the southwestern part of the State. Not infrequent.

Flowers in July and August.

Vigo (Blatchley); Starke (Hill).

PHALARIS L.

P. ARUNDINACEA L. Reed Canary Grass.

An evident escape from gardens in a few counties of the State.

As an escape usually found in moist, rich soils.

Flowers in July and August.

Fayette (Hessler); Gibson.

P. CANARIENSIS L. Canary Grass.

This species "escapes" in almost every locality in which it is cultivated. It frequently occupies waste places completely. Brought into cultivation for the seeds, which are a favorite food of canary birds.

Flowers in July and August.

Fayette (Hessler); Jefferson and Gibson; Steuben (Bradner).

ANTHOXANTHUM L.

A. ODORATUM L. Sweet Vernal-grass.

Found sparingly throughout the State in meadows and at the borders of cultivated fields. Quite frequent in the southern counties. Very fragrant in drying.

Flowers in June and July.

Vigo (Blatchley); Marion.

ARISTIDA L.

A. DICHOTOMA Michx. Poverty Grass.

Frequent in the southern counties in dry, sandy places and along railway embankments. Of no great economic value.

Flowers in August.

Vigo (Blatchley).

A. GRACILIS Ell.

In the southern counties, in dry soil, usually growing in tufts. Of little, if any, economic value.

Flowers in August and September.

Jefferson.

A. RAMOSISSIMA Engelm.

Found in dry, sandy soil in the southern part of the State. Not frequent.

Flowers in August and September.
Jefferson and Gibson.

A. PURPURASCENS Poir.

Found growing in dry soils in many counties of the State, chiefly western. Quite common, but of no economic value.

Flowering season, August and September.

A. OLIGANTHA Michx.

Found in the counties bordering the Ohio and lower Wabash rivers, growing in dry soil.

Flowers in August and September.
Jefferson and Gibson.

A. TUBERCULOSA Nutt. Sea-beach Aristida.

In sandy soil along the lake beach.

Flowering season, from August to September.
Lake (Hill).

STIPA L.

S. SPARTEA Trin. Porcupine Grass.

In sands and sandy prairies in the northwestern part of the State. Frequent but not abundant.

Flowers in June and July.
Lake (Hill).

ORYZOPSIS Michx.

O. ASPERIFOLIA Michx. White-grained Mountain Rice.

Found in rich woods, especially in the northern counties of the State, where it is at times quite plentiful.

Flowers in May and June.

O. MELANOCARPA Muhl. Mountain Rice.

Quite frequent throughout the State in rocky woods. Especially plentiful in the southern hill counties.

Flowers in July and August.
Jefferson.

MILIUM L.

M. EFFUSUM L. Tall Millet Grass.

Growing in damp woods in the northern counties of the State.
 "The plants multiply by the roots as well as by the seeds, thereby rendering it of considerable value for a permanent, wet station."
 (Troop.)

Flowers in July and August.

MUHLENBERGIA Schreb.

M. SOBOLIFERA (Muhl.) Trin.

A small species with upright stem, commonly found throughout the State in rocky soils in woods and thickets.

Flowers in August and September.

Jefferson and Gibson.

M. MEXICANA (L.) Trin.

In swamps and low, moist places, in most parts of the State. Quite plentiful. This species is readily eaten by cattle.

Flowers from late in July until early in September.

Shriner Lake (Deam); Vigo (Blatchley).

M. RACEMOSA (Michx.) B. S. P.

(*M. glomerata* Trin.)

Found in marshes in nearly all of the northern counties, where it forms a large portion of the marsh hay.

Flowers in August and September.

Lake (Hill); Steuben (Bradner).

M. SYLVATICA Torr.

Common everywhere along the banks of streams and in moist woods.

Flowers in August and September.

Vigo (Blatchley).

M. TENUIFLORA (Willd.) B. S. P.

(*M. Willdenovii* Trin.)

Common in dry or rocky soils, in shaded places, throughout the State.

Flowers in August and September.

Jefferson.

M. DIFFUSA Schreb.

Common in dry soils; in the southern counties this species forms the main portion of the woods pasture.

Flowers in August and September.

Vigo (Blatchley); Marion, Jefferson, and Gibson.

M. CAPILLARIS (Lam.) Trin. Long-awned Hair-grass.

"Found in sandy soil in Marion County and occasionally in other localities." (Troop.)

Flowers in August and September.

Marion.

BRACHYELYTRUM Beauv.

B. ERECTUM (Schreb.) Beauv.

(*B. aristatum* Beauv.)

Common in moist woods in all parts of the State. Under natural conditions it does not grow thick enough to produce any considerable quantity of feed.

Flowers in June and July.

Gibson.

PHLEUM L.

P. PRATENSE L. Timothy.

Common throughout the State, in fields and along roadsides. It is largely cultivated and furnishes more hay, in our area, than any other species in cultivation.

Flowers in July and August.

Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

ALOPECURUS L.

A. GENICULATUS L. Marsh Foxtail.

(*A. geniculatus aristulatus* Torr.)

In marshy places, probably throughout the State. It has some value as a wet pasture grass.

Flowers in June and July.

Cass (Hessler); Hamilton (Wilson); Floyd (Clapp); Marshall (Hessler); Southern counties; Steuben (Bradner).

A. PRATENSIS L. Meadow Foxtail.

This species has become thoroughly naturalized and is found in most parts of the State, growing in pastures and meadows. It matures earlier than timothy, which it somewhat resembles in general appearance. Valuable as a pasture plant because of its early appearance.

Flowers in May and June.

SPOROBOLUS R. Br.

S. ASPER (Michx.) Kunth. Rough Rush-grass.

Found in the southwestern part of the State, where it is common in dry, sandy fields. The plant is too rough and coarse to have any value as a forage plant.

Flowers in August and September.

Vigo (Blatchley); Gibson and adjoining counties.

S. VAGINÆFLORUS (Torr.) Wood. Sheathed Rush-grass.

Common in the counties along the Ohio river, in dry, sandy soil.

Flowers in August and September.

Jefferson (Barnes).

S. CRYPTANDRUS (Torr.) Gray. Sand Dropseed.

Found in many parts of the State, growing in sandy soil in open places. A favorite forage plant with cattle and sheep.

Flowers in August and September.

Lake (Hill).

S. HETEROLEPIS Gray. Northern Dropseed.

It is found in the southwestern counties, growing in dry soil. "It makes fair hay but is not very productive." (Troop.)

Flowers in August.

Gibson and adjoining counties (Troop); Lake (Hill).

CINNA L.

C. ARUNDINACEA L. Wood Reed-grass.

A coarse grass growing in wet woods and marshes. Common and abundant throughout the State. The large leaves furnish a considerable quantity of very coarse, inferior fodder.

Flowers in July and August.

Tippecanoe (King); Fayette (Hessler); Vigo (Blatchley); Hamilton and Mariou (Wilson); Jefferson and Gibson.

AGROSTIS L.

A. ALBA L. Red-top. Herd's-grass.

(Includes *A. alba vulgaris* Thurb.)

An extremely variable form found in all parts of the State in moist, rich soils. It is largely cultivated for hay, and is also used

as a lawn grass, for this purpose being mixed with blue-grass. In most of our area the species is abundant, making one of our best meadow and pasture grasses.

Flowers in June and July.

Tippecanoe (Hussey); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

A. CANINA L. Brown Bent-grass.

"A low species, six to eighteen inches high, with a loose panicle and spikelets of a purplish color. It varies greatly in different localities. Found occasionally in various parts of the State." (Troop.)

Flowers from July until September.

A. PERENNANS (Walt.) Tuckerm. Thin-grass.

Of frequent occurrence throughout the State, growing in damp, shady places. Eaten readily by cattle and sheep.

Flowers from July until September.

Fayette (Hessler); Vigo (Blatchley); Jefferson.

A. HYEMALIS (Walt.) B. S. P. Hair-grass.

(*A. scabra* Willd.)

Widely distributed through the State, growing in either dry or moist soil. Plentiful in most of its stations, but of little value.

Flowers in June and July.

Vigo (Blatchley).

A. ALTISSIMA (Walt.) Tuckerm. Tall Bent-grass.

(*A. elata* Trin.)

"Found in Tippecanoe County in moist woods; quite abundant late in autumn, when it adds considerably to late fall feed." (J. Troop.)

Flowers in August and September.

A. INTERMEDIA Scribn. Upland Bent-grass.

Reported only from Vigo County, where this species was found growing in sparing numbers on dry hillsides.

Flowering specimens collected in August.

Vigo (Blatchley).

CALAMAGROSTIS Adans.

C. CANADENSIS (Michx.) Beauv. Blue-joint Grass.

Found in marshes and low, wet meadows and prairies in many counties of the State. It is one of the most productive of the marsh grasses and is frequently cut for hay.

Flowers in July and August.

Tippecanoe (Cunningham); Vigo (Blatchley); Marion and Lake; Steuben (Bradner).

C. CONFINIS (Willd.) Nutt. Bog Reed-grass.

Confined to the northern counties of the State, where it is found growing in swamps and low, wet bottom lands.

Flowers in July and August.

AMMOPHILA Host.

A. ARENARIA (L.) Link. Sea Sand-reed. Sea Mat-weed.

(*Calamagrostis arenaria* Roth.)

Found along the shores of Lake Michigan.

Flowers from August to September.

Lake (Hill).

CALAMOVILFA Hack.

C. LONGIFOLIA (Hook.) Hack. Reed-grasses.

(*Calamagrostis longifolia* Hook.)

On the beaches and sand stretches about the southern shore of Lake Michigan; probably confined to Lake and Porter counties.

Flowers in July and August.

Lake (Hill).

HOLCUS L.

H. LANATUS L. Velvet-grass.

Escaped from cultivation in many localities, and found in fields and waste places, apparently thriving best in moist soils.

Flowers in June and July.

Floyd (Clapp).

DESCHAMPSIA Beauv.

D. CAESPITOSA (L.) Beauv. Tufted Hair-grass.

In wet places on shores of lakes and streams.

Flowering season from July until August.

Steuben (Bradner).

D. FLEXUOSA (L.) Trin. Common Hair-grass.

Common in dry soil, in many parts of the State.

Flowers in June and July.

TRISETUM Pers.

T. PENNSYLVANICUM (L.) Beauv. Marsh False Oat.

(*T. palustre* Torr.)

Common in low, wet soils, in various counties of the State, perhaps more abundantly northward.

Flowers in June and July.

ARRHENATHERUM Beauv.

A. ELATIUS (L.) Beauv. Oat Grass.

(A. avenaceum Beauv.)

This species has escaped from cultivation in different parts of the State, more commonly to the south. It is a very vigorous grower and is recommended as a mixture with other grasses for hay or pasturage.

Flowers in May and June.

Jefferson and Marion.

DANTHONIA DC.

D. SPICATA (L.) Beauv. Wild Oat Grass.

Found growing sparingly in dry woods and shaded places in various counties of the State. Sheep and cattle do not eat it when they can obtain other grasses.

Flowers in June and July.

Jefferson (Barnes); Fayette (Hessler).

D. COMPRESSA Austin.

Having much the same range as the preceding, though perhaps of less frequent occurrence. It commonly grows in dry woods and is said to furnish good pasturage.

Flowers in July and August.

CAPRIOLA Adans.

C. DACTYLON (L.) Kuntze. Bermuda Grass.

(Cynodon Dactylon Pers.)

Sparingly introduced in the southern counties. Cultivated for pasture somewhat, but of doubtful value in our area because of its late appearance in the spring. It is also likely to become troublesome to field crops, its deep, stout root-stocks making it hard to kill.

Flowers from July until September.

SPARTINA Schreb.

S. CYNOSUROIDES (L.) Willd. Fresh-water Cord-grass. Wild Tall Marsh-grass.

Found in the northern counties in considerable abundance in swamps and sluggish streams. It is at times used for hay, being cut when very young.

LaPorte (Barnes); Lake (Hill); Steuben (Bradner).

BOUPELOUA Lag.

B. CURTIPENDULA (Michx.) Torr.

(*B. racemosa* Lag.)

Very abundant on a hillside in Winona Park, Kosciusko County, in a plat about one rod square, but seen nowhere else. The soil in which it was growing was very dry and sandy. Reported also by Mr. E. Bradner.

Flowers in July and August.

Kosciusko (Chipman); Steuben (Bradner).

ELEUSINE Gaertn.

E. INDICA (L.) Gaertn. Crab grass. Yard-grass. Wire-grass.

Common throughout the State in dooryards and waste places. The species is of no special value and at times becomes annoying in lawns.

Flowers from June until September.

Steuben (Bradner).

DACTYLOCTENIUM Willd.

D. AEGYPTIUM (L.) Willd. Egyptian Grass.

(*Eleusine Aegyptia* Pers.)

Found in waste places and cultivated fields in the southern counties. It has become thoroughly naturalized and maintains itself strongly.

Flowers from July until October.

Gibson.

PHRAGMITES Trin.

P. PHRAGMITES (L.) Karst. Reed.

(*P. communis* Trin.)

In swamps and low wet soils in various parts of the State. More abundant northward, where it is frequently found covering large areas about the low lying lands near the outlets of the small lakes.

Flowers from August through October.

Cass and Marshall (Hessler); Vigo (Blatchley); Steuben (Bradner).

SIEGLINGIA Bernh.

S. SESLERIODES (Michx.) Scribn. Tall Red-top.

(*Triodia cuprea* Jacq.)

Found commonly throughout the State, in dry, sandy fields and waste places. The purple, spreading panicle makes it a very showy grass. If cut early, the species makes good hay, but the fully matured stems are too hard to be relished by stock.

Flowers in August.

Tippecanoe (Cunningham); Vigo (Blatchley.)

ERAGROSTIS Beauv.

E. CAPILLARIS (L.) Nees.

A handsome grass found somewhat commonly in the State, growing in dry soils. It is more likely to be found in sandy soils or upon dry sand banks.

Flowers in August and September.

Hamilton (Wilson); Jefferson.

E. FRANKII Steud.

Found in dry, sandy ground, rather commonly throughout the State. It usually grows in tufts in cultivated fields.

Flowers in August.

Jefferson (Barnes); Fayette (Hessler); Vigo (Blatchley); Hamilton (Wilson); Gibson.

E. PILOSA (L.) Beauv.

Of infrequent occurrence in the State, usually growing on gravelly banks along railways.

Flowers in August and September.

Fayette (Hessler); Vigo (Blatchley); Gibson; Steuben (Bradner).

E. PURSHII Schrad.

Quite common throughout the State in dry, sandy soils in waste places or cultivated fields.

Flowers in August and September.

Jefferson (J. M. Coulter); Lake (Hill); Vigo (Blatchley).

E. ERAGROSTIS (L.) Karst.

(*E. minor* Host.)

In waste places and about the edges of cultivated fields. Neither so abundant nor so widely distributed as the species following.

Flowers in July and August.

Tippecanoe (Cunningham); Hamilton and Marion (Wilson) Steuben (Bradner).

E. MAJOR Host.

Commonly found in gardens and along roadsides in late summer. In some localities a persistent and annoying weed. The flattened spikelets bearing numerous lead-colored flowers make it a handsome grass. Unpleasantly scented.

Flowers from July until September.

Tippecanoe (Cunningham); Vigo (Blatchley); Hamilton and Marion (Wilson).

E. PECTINACEA (Michx.) Steud.

Common throughout the State, growing in dry sandy soils. This species includes *E. pectinacea spectabilis* Gray, which is reported as occurring in the central counties of the State.

Flowers in August.

Vigo (Blatchley); Marion.

E. TRICHODES (Nutt.) Nash.

(*E. tenuis* Gray.)

Quite common throughout the State, growing in dry, sandy soil.

Flowers in August and September.

Fayette (Hessler); Marion and Gibson.

E. HYPNOIDES (Lam.) B. S. P.

(*E. reptans* Nees.)

A small, spreading species found growing on sandy and gravelly banks of streams and on bars. Of frequent occurrence.

Flowers in our area in July and August.

Jefferson (Barnes); Hamilton (Wilson); Vigo (Blatchley); Steuben (Bradner).

EATONIA Raf.

E. OBTUSATA (Michx.) Gray.

Reported only from the southern part of the State, where it is found in dry, shaded places. It furnishes but a small amount of pasturage because of its sparsely growing habit.

Flowers in June and July.

E. PENNSYLVANICA (DC.) A. Gray.

Commonly found throughout the State in open woods or upon shaded hillsides in moist soils. Readily eaten by cattle, but not suitable for pasture on account of its thin growth habit.

Flowers in June and July.

Fayette (Hessler); Vigo (Blatchley); Gibson.

KOELERIA Pers.

K. CRISTATA (L.) Pers.

Quite generally distributed throughout the State, but not generally recognized. Found on high, dry lands, growing in tufts.

Flowers from June through August.

Laporte (Barnes); Gibson.

MELICA L.

M. DIFFUSA Pursh.

In open places in dry or moist soils. Reported only from northern part of State, but probably of general occurrence.

Flowers in May and June.

Tippecanoe (Cunningham).

M. MUTICA Walt.

Found in rich soils in shaded places, where it grows in tufts. It is reported only from the southern counties, but doubtless occurs elsewhere.

Flowers in June and July.

KORYCARPUS Zea.

K. DIANDRUS (Michx.) Kuntze.

(*Diarrhena Americana* Beauv.)

Found in rich soils in shaded places in the counties bordering the Ohio River and the lower Wabash. "It would doubtless prove valuable for hay if a thick stand could be secured" (Troop).

Flowers in August and September.

Jefferson (Young).

UNIOLA L.

U. LATIFOLIA Michx.

A handsome grass, two or three feet in height, growing in moist, rich soils. So far, reported only from the southern counties.

Flowers in August.

Jefferson (Barnes).

DACTYLIS L.

D. GLOMERATA L. Orchard Grass.

Well distributed throughout the State, growing at the borders of fields, by roadsides and in yards. "It is considered by those who have used it as one of the most valuable of all grasses. Many farmers who have tried it prefer it to timothy for mixing with clover, as it ripens with the clover, while timothy ripens later. As a pasture grass it is hard to excel." (Troop.)

Flowers in June and July.

Tippecanoe (Cunningham); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

POA L.

P. ANNUA L. Low Spear-grass.

Found throughout the State, especially by yards and roadsides. Cattle and sheep are very fond of it green, but its small size, three to six inches in height, makes it valueless for hay.

Commences to blossom in May and continues through the summer. Vigo (Blatchley); Lake (Hill); Marion, Steuben (Bradner).

P. COMPRESSA L. Wire-grass.

Found throughout the State, growing in old pastures and waste places. "It is considered very nutritious, but does not yield enough to make it pay as a hay crop." (Troop.)

Flowers in June and July.

St. Joseph (Barnes); Fayette (Hessler); Jefferson and Marion; Steuben (Bradner).

P. PRATENSIS L. Kentucky Blue-grass. June-grass.

A very valuable grass, found in every part of the State. Grows in open or shaded places, being most luxuriant in rich, moist soils. Largely cultivated for hay and pasture, and also frequently used for lawns.

Flowers in May and June.

Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

P. TRIVIALIS L. Rough Meadow-grass.

"A species resembling *P. pratensis*, except that the leaves are more or less rough and the panicle longer and branches more distant. Found abundantly in moist meadows." (Troop.)

Flowers in June and July.

Floyd and Marion.

P. FLAVA L. Fowl Meadow-grass. False Red-top.

(*P. serotina* Ehrh.)

Commonly found throughout the State, always growing in moist, rich soil. It is a valuable grass for hay, but its habit of growing in tufts makes it necessary to mix it with some other species if the best results are secured.

Flowers in July and August.

Vigo (Blatchley); Steuben (Bradner).

P. DEBILIS Torr.

"Found sparingly in dry woods in Tippecanoe County, flowering in May." (Troop.)

Steuben (Bradner).

P. SYLVESTRIS Gray.

In thickets and meadows in many parts of the State. Of no great value for hay or pasture.

Flowers in June and July.

Jefferson (Barnes); Fayette (Hessler).

P. ALSODES Gray.

Reported only from the southeastern counties, where it is found growing in thickets and woods.

Flowers in May and June.

P. BREVIFOLIA Muhl.

Found in dry, rocky woods in the counties bordering the Ohio River.

Flowers in April and May.

Floyd (Clapp).

PANICULARIA Fabr.

P. CANADENSIS (Michx.) Kuntze. Rattlesnake Grass.

(*Glyceria Canadensis* Trin.)

Growing in roadside ditches and in marshy places. An ornamental form, largely used in bouquets, the panicles in some cases being dyed in bright colors.

Flowers in July and August.

Gibson; Steuben (Bradner).

P. OBTUSA (Muhl.) Kuntze. Blunt Manna-grass.

(*Glyceria obtusa* Trin.)

Reported only from the southern counties, where it grows in marshes and low, wet grounds.

Flowers in July and August.

P. ELONGATA (Torr.) Kuntze. Long Manna-grass.

(*Glyceria elongata* Trin.)

Reported from the northern counties, growing in rich, wet woods

Flowers in July and August.

Clark.

P. NERVATA (Willd.) Kuntze.

(*Glyceria nervata* Trin.)

Found throughout the State, growing about the margins of ponds and in low, moist grounds. A nutritious grass which may be profitably mixed with other species in wet grounds.

Flowers from June until September.

Jefferson (Barnes); Fayette (Hessler); Vigo (Blatchley); Steuben (Bradner).

P. AMERICANA (Torr.) MacM. Reed Meadow-grass.*(Glyceria grandis S. Wats.)*

Common throughout the State in very wet places and in shallow, stagnant water.

Flowers from June until August.

P. PALLIDA (Torr.) Kuntze. Pale Manna-grass.*(Glyceria pallida Trin.)*

Found in shallow water in various parts of the State; more abundant in the northern counties.

Flowers in July and August.

Jefferson.

P. FLUITANS (L.) Kuntze. Floating Manna-grass.*(Glyceria fluitans R. Br.)*

Found in shallow waters and on the low margins of sluggish streams. The species is abundant, but too coarse for hay.

Flowers in July and August.

Jefferson and Gibson; Steuben (Bradner).

FESTUCA L.

F. OCTOFLORA Walt. Slender Fescue-grass.*(F. tenella Willd.)*

Reported only from southern counties, growing in dry, sandy soils.

Flowers in June and July.

Jefferson (Barnes).

F. OVINA L. Sheep's Fescue-grass.

In fields and waste places in the northern part of the State.

Flowering season from June until July.

Lake (Hill).

F. ELATIOR L. Tall Fescue-grass.

Widely distributed in the State, growing in cultivated fields, in waste places and by roadsides. Cultivated to some extent, giving a large quantity of hay.

Flowers in July and August.

Gibson.

F. NUTANS Willd. Nodding Fescue-grass.

Found in dry, shaded places, in various parts of the State, chiefly to the southward. Of little, if any, value for hay or pasture.

Flowers in June and July.

Fayette (Hessler); Vigo (Blatchley); Jefferson and Gibson.

BROMUS L.

B. CILIATUS L. Wood Chess.

Fairly common throughout the State, growing in woods and thickets in moist, sandy soils. A very variable species.

Flowers in July and August.

Laporte (Barnes); Vigo (Blatchley); Steuben (Bradner).

B. KALMI Gray. Wild Chess.

Common in most parts of the State, growing in dry soil in shaded places.

Flowers in July and August.

Gibson.

B. SECALINUS L. Cheat. Chess.

In fields and waste places in every part of the State. Very often a pernicious weed in grain fields. This is the grass that at one time was believed by many grain growers to come from wheat, a belief that has not yet wholly died out.

Flowers in June and July.

Vigo (Blatchley); Hamilton and Marion; Steuben (Bradner).

B. RACEMOSUS L. Upright Chess.

Found in situation similar to the preceding, for which it is frequently mistaken. It is also found growing sparsely along the banks of streams.

Flowers in June and July.

Vigo (Blatchley); Jefferson and Gibson.

LOLIUM L.

L. PERENNE L. Rye-grass.

Escaped from cultivation and found sparingly in various counties of the State. It grows in meadows and pastures, but most abundantly on the borders of cultivated fields. A satisfactory grass for mixed hay or pasture.

Flowers in June and July.

Vigo (Blatchley).

AGROPYRON J. Gaertn.

A. REPENS (L.) Beauv. Couch or Quack Grass.

Found throughout the State, usually being very abundant in its stations. A valuable grass for permanent pasture or meadow. "It spreads very rapidly by means of underground rootstalks, which throw out roots at every joint, and when these are broken up by the

plow or harrow, form separate plants. Hence when fields infested by it are wanted for crops it becomes very troublesome." (Troop.)

Flowers from June through August.

Vigo (Blatchley); Marion; Steuben (Bradner).

A. VIOLACEUM (Hornem.) Vasey. Purplish Wheat Grass.

Reported from Lake County, growing sparingly in dry sandy soil.

Flowers in June.

Lake (Hill).

HORDEUM L.

H. NODOSUM L. Meadow Barley.

(*H. pratense* Huds.)

Found along the lower Wabash and in meadows and waste places in the southern counties. When young it is eaten by stock, but is worthless for forage when mature because of its long barbed awns.

Flowers in June and July.

Gibson; Knox (Spillman).

H. JUBATUM L. Wild Barley. Squirrel-tail Grass.

Found sparingly on sandy or gravelly land in various parts of the State. Of no value in our range.

Flowers in July and August.

Hamilton and Marion (Wilson).

ELYMUS L.

E. STRIATUS Willd. Slender Wild Rye.

A common form growing in woods and on banks in many counties of the State. Of no especial value.

Flowers in June and July.

Jefferson (Young); Fayette (Hessler); Hamilton and Marion (Wilson); Gibson.

E. VIRGINICUS L. Wild Rye.

Common throughout the State, occurring most plentifully in moist, sandy soils in shaded places. While the species has some value farther south, it is practically worthless in our area.

Flowers in July and August.

Vigo (Blatchley); Steuben (Bradner).

E. CANADENSIS L.

Similar to the preceding and found in many counties in fair abundance. It grows on the banks of streams and railways in moist, sandy soil.

Flowers in July and August.

Tippecanoe (Cunningham); Vigo (Blatchley); Steuben (Bradner).

HYSTRIX Moench.

H. HYSTRIX (L.) Millsp. Hedge-hog Grass.
(*Asprella Hystrix* Willd.)

A coarse grass found quite abundantly in moist, rocky woods. Easily distinguished from *Elymus* by its very loose spike.

Flowers from June until in August.

Hamilton and Marion (Wilson); Steuben (Bradner).

ARUNDINARIA Michx.

A. TECTA (Walt.) Muhl. Small Cane.
(*A. macrosperma suffruticosa* Munro.)

“Found in swamps in the southwestern counties, growing from two to twenty-five feet high and with a stem diameter of from one to three inches. The leaves furnish an abundant food supply for cattle.” (Troop.)

Flowers in May and June.

CYPERACEÆ. Sedge Family.

CYPERUS L.

C. FLAVESCENS L. Yellow Cyperus.

In low grounds or marshes. Reported only from the southern counties, but probably of more general distribution.

Flowers August and September.

Jefferson.

C. DIANDRUS Torr. Low Cyperus.

Common throughout the State in marshy places and in low, wet, sandy soil.

Flowers from August through October.

Tippecanoe (Cunningham); Jefferson (Barnes); Putnam (MacDougal); Hamilton (Wilson); Vigo (Blatchley); Steuben (Bradner).

C. RIVULARIS Kunth.

In wet soils about the margins of lakes and along the shores of rather sluggish streams. Reported only from the northern part of the State, though doubtless of wider distribution. It is probably not separated from *C. diandrus*, which it closely resembles.

Flowers in August and September.

Round Lake (Deam).

C. INFLEXUS Muhl. Awned Cyperus.

Reported only from the southern part of the State, as growing sparsely in wet, sandy soils.

Flowers from July through September.
Jefferson and Allen.

C. SCHWEINITZII Torr.

Found along sluggish streams and about the shores of lakes and ponds, in sandy soil. Reported only from the northern counties, but doubtless occurring in favorable situations throughout the State.

Flowers from early August through September.
Laporte (Barnes).

C. ESCULENTUS L. Yellow Nut-grass.

Reported from the southern counties as growing in open places in moist soils. Usually abundant in the stations in which it occurs.

Flowers in August and September.
Jefferson (Barnes).

C. ERYTHORRHIZOS Muhl. Red-rooted Cyperus.

Throughout the State, along streams and upon the margins of lakes and ponds in wet soils.

Flowers in August and September.
Hamilton (Wilson); Putnam (MacDougal); Steuben (Bradner).

C. SPECIOSUS Vahl.

Reported from southern counties only. Found in marshes, or in low, wet sandy soils. Not frequent.

Flowers from July until late in September.
Vigo (Blatchley); Jefferson (Barnes).

C. ENGELMANNI Steud.

About the margins of lakes in wet soils, usually sandy loams, in the northern counties.

Flowers from August through October.
Shriner Lake (Deam); Lake (Hill).

C. STRIGOSUS L. Straw-colored Cyperus.

This species is of general occurrence throughout the State and is abundant in all stations. Found growing in moist soils in open places, being especially abundant in marshes and along streams.

Flowers in August and September.
Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

C. OVULARIS (Michx.) Torr. Globose Cyperus.

Reported from various counties of the State, as of sparing occurrence. The species grows in dry soils, usually on high ground.

Flowers in July and August.

Jefferson, Gibson, and Lake.

C. FILICULMIS Vahl. Slender Cyperus.

Reported only from the northern counties, but probably of general distribution in favorable situations. Found growing in dry, upland soils.

Flowers from June through August.

Lake and Laporte.

KYLINGA Rottb.

K. PUMILA Michx.

In the southern counties of the State, growing in low, sandy soils, either in waste places or cultivated fields. Of frequent occurrence.

Flowers in August and September.

Jefferson (Barnes); Vigo (Blatchley).

DULICHIMUM L. C. Richard.

D. ARUNDINACEUM (L.) Britton.

(*D. spathaceum* Pers.)

Throughout the State, in wet places. Found most abundantly on the borders of marshes and along streams.

Flowers from July through September.

Laporte (Barnes); Round Lake (Deam); Vigo (Blatchley); Steuben (Bradner).

ELEOCHARIS R. Br.

E. INTERSTINCTA (Vahl.) R. and S. Knotted Spike-rush.

Found in shallow waters in the smaller inland lakes and along the margins of sluggish streams. Reported only from northern counties.

Flowers from July until in September.

Round Lake (Deam).

E. MUTATA (L.) R. and S. Quadrangular. Spike-rush.

(*E. quadrangulata* R. Br.)

Reported from the northern counties, where it is found growing in ponds and shallow lakes, and occasionally in sluggish streams.

Flowers from July through September.

Round Lake (Deam); Steuben (Bradner); Kosciusko (Chipman); Lake (Hill).

E. OLIVACEA Torr. Bright Green Spike-rush.

In marshes in the southwestern part of the State. The species in its mass distribution is near the coast, and its occurrence in our area is exceptional.

- Flowers in August and September.
Gibson (Schneck); Lake (Hill).

E. CAPITATA (L.) R. Br.

In wet soils in the southern counties of the State. Abundant in favorable situations.

Flowers in our area in July and August.
Vigo (Blatchley); Lake (Hill).

E. OVATA (Roth.) R. and S.

Found throughout the State in wet soil, usually somewhat sandy or clayey. Very abundant and very variable. It is also often found in shallow water, at the margins of ponds and ditches.

Flowers from June through September.

Tippecanoe (Cunningham); Kosciusko (Chipman); Jefferson (Barnes); Noble (Van Gorder); Vigo (Blatchley); Hamilton (Wilson); Steuben (Bradner).

E. ENGELMANNI Steud.

Found somewhat sparingly in various counties of the State, grows in wet soil and occasionally found in shallow water.

Flowers in July and August.
Putnam (MacDougal).

E. PALUSTRIS (L.) R. and S. Creeping Spike-rush.

Found in marshes and the shallow waters of ponds and lakes in the northern counties. Plentiful in stations in which it is found.

Flowers in August and September.
Laporte (Barnes).

E. ACICULARIS (L.) R. and S. Needle Spike-rush.

In low, muddy places about ponds and streams. Well distributed, but never abundant.

Flowers in July and August.
Laporte (Barnes); Vigo (Blatchley); Steuben (Bradner).

E. MELANOCARPA Torr.

In wet sands in or near the southern shores of Lake Michigan. Not found far removed from the lake.

Flowers in July and August.
Lake and Laporte (Hill).

- E. TENUIS** (Willd.) Schultes. Slender Spike-rush.
 Not uncommon, especially in the southern counties. Found on moist banks and in damp open places.
 Flowers from May until August.
 Vigo (Blatchley).
- E. ROSTELLATA** Torr. Beaked Spike-rush.
 Found in the swamp regions of the southwestern counties and also in low, wet meadows.
 Flowers in August and September.

STENOPHYLLUS Raf.

- S. CAPILLARIS** (L.) Britton.
 (*Fimbristylis capillaris* Gray.)
 Throughout the State, but not abundant. It is usually found on dry, sandy banks or on the borders of cultivated areas.
 Flowers in July and August.
 Vigo (Blatchley).

FIMBRISTYLIS Vahl.

- F. CASTANEA** (Michx.) Vahl. Marsh Fimbristylis.
 (*F. spadicca castanea* Gray.)
 Occurs in Lake County in wet soil.
 Flowering season from July to September.
 Lake (Hill).
- F. AUTUMNALIS** (L.) R. and S.
 In low, moist places, usually in sandy soils. Found in most parts of the State, but nowhere abundant.
 Flowers from June through September.
 Jefferson (J. M. Coulter); Vigo (Blatchley).

SCIRPUS L.

- S. SUBTERMINALIS** Torr. Water Club-rush.
 In swamps and shallow waters of lakes and ponds in the extreme northern counties.
 Flowers in July and August.
 Lake (Hill).
- S. DEBILIS** Pursh. Weak-stemmed Club-rush.
 In wet soils about marshes and the borders of lakes and streams in the northern counties.
 Flowers in July and August.
 Lake (Hill).

S. SMITHII Gray.

In muddy places at the borders of lakes and sluggish streams.

Reported only from the northern counties.

Flowers from July until in September.

Laporte.

S. AMERICANUS Pers. Chair-maker's Rush.

(*S. pungens* Vahl)

In all parts of the State in the shallower waters of ponds and lakes and along their borders.

Flowers from June until late in September.

Noble (Van Gorder); Shriner Lake (Deam); Vigo (Blatchley);

Hamilton (Wilson); Steuben (Bradner).

S. TORREYI Olney.

Found occasionally in swamps in the northern part of the State.

Not abundant in any of its stations.

Flowers from July until September.

Lake and Porter (Hill).

S. LACUSTRIS L. Great Bulrush. Mat Rush.

Throughout the State in ponds and swamps and sluggish streams.

Very abundant northward in the regions of the Kankakee marshes and of the shallower inland lakes.

Flowers from June until September.

Tippecanoe (Cunningham); Noble (Van Gorder); Vermillion (Wright); Putnam (MacDougal); Shriner Lake (Deam); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

S. FLUVIATILIS (Torr.) Gray. River Bulrush.

Found in various parts of the State in the shallow waters along the margins of streams and ponds. Usually abundant in its stations.

Flowers from June until late in September.

Vigo (Blatchley).

S. ATROVIRENS Muhl. Dark-green Bulrush.

Throughout the State in swamps and low, wet meadows and prairies. Abundant wherever found.

Flowers from June until late in September.

Tippecanoe (Cunningham); Noble (Van Gorder); Shriner Lake (Deam); Vigo (Blatchley); Hamilton and Marion (Wilson).

S. POLYPHYLLUS Vahl. Leafy Bulrush.

In the swamps of the southwestern counties; also in wet woods and meadows in the majority of the southern counties.

Flowers from July until September.

S. LINEATUS Michx. Reddish Bulrush.

On the margins of lakes in low, wet ground and in wet, open places. Found throughout the State.

Flowers from June until in September.

Decatur (Ballard); Shriner Lake (Deam).

S. CYPERINUS (L.) Kunth. Wool-grass.

(*Eriophorum cyperinum* L.)

Found in many parts of the State in swamps and the margins of lakes and sluggish streams. Apparently more abundant in the northern part of the State.

Flowers in August and September.

Tippecanoe (Cunningham); Noble (Van Gorder); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

ERIOPHORUM L.

E. VAGINATUM L. Sheathed Cotton-grass.

Reported only from the northern part of the State as growing in swamps. The species is admitted somewhat doubtfully, our area being well south of the general distribution of the form.

Flowering season, June and July.

Steuben (Bradner).

E. POLYSTACHYON L. Tall Cotton-grass.

Occurring in very wet grounds in Putnam County, upon the authority of Dr. MacDougal. So far as has come to my knowledge, the only record for the State.

Flowers from June through August.

Putnam (MacDougal).

E. GRACILE Koch. Slender Cotton-grass.

In bogs in the northern counties.

Flowering season from June until September.

Lake (Hill); Steuben (Bradner).

E. VIRGINICUM L.

In marshes and low, wet meadows in many counties of the State, but not abundant in any of its stations.

Flowers from June until late in September.

Laporte (Barnes); Noble (Van Gorder); Vigo (Blatchley).

HEMICARPHA Nees and Arn.

H. MICRANTHA (Vabl.) Britton.

(H. subsquarrosa Nees.)

In moist, sandy places about the southern shores of Lake Michigan.
 Not reported farther south.
 Flowering in July and August.
 Porter (Hill).

RYNCHOSPORA Vahl.

R. CORNICULATA (Lam.) Gray. Horned-rush.

In marshes and low, wet open places in the southern counties of the State. Sparingly found.
 Flowers in July and August.
 Floyd (Clapp).

R. ALBA (L.) Vahl. White Beaked-rush.

In marshes and swamps; reported only from the northern counties of the State.
 Flowers in June and August.
 Noble (Barnes); Steuben (Bradner).

R. CAPILLACEA LAEVISETA E. J. Hill.

Reported only from the northern counties in bogs and low, wet grounds.
 Flowers in July and August.
 Lake (Hill). Vahl.

R. GLOMERATA (L.) Vahl.

In moist soils in the northern counties of the State. Of frequent occurrence in the regions in which it is found.
 Flowers from July through September.
 Laporte (Barnes); Round Lake (Deam).

R. CYMOSA Ell.

In wet soils and about the margins of lakes, in the northern counties of the State.
 Flowers from June through August.
 Lake (Hill).

CLADIUM P. Br.

C. MARISCOIDES (Muhl.) Torr. Twig-rush.

Reported from various counties, growing in marshes and low, wet places. The recorded stations are from the northern counties, although it is probably to be found throughout the State.

Flowers in July and August.

Noble (Van Gorder); Shriner Lake (Deam).

SCLERIA Berg.

S. TRIGLOMERATA Michx. Tall Nut-grass.

In the northern part of the State, usually found in very wet, shaded places.

Flowers in July and August.

Lake.

S. VERTICILLATA Muhl. Low Nut-grass.

Found in moist meadows and prairies in various counties of the State. Apparently chiefly southern in its distribution in our area. Plant quite fragrant in drying.

Flowers from July through September.

Lake.

CAREX L.

C. INTUMESCENS Rudge. Bladder Sedge.

Commonly found throughout the State, growing in marshy places and wet woods.

Flowers from early in May until October.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Noble (Van Gorder); Putnam (MacDougal).

C. ASA-GRAYI Bailey.

(*C. Grayi* Carey.)

Found quite abundantly throughout the State in marshes and wet, open places. More plentiful in the southern counties.

Flowers from June until October.

Daviess (Clements); Noble (Van Gorder); Knox (Spillman); Vigo (Blatchley).

C. LUPULINA Muhl. Hop Sedge.

Abundant in all parts of the State, growing in low, wet woods and in bogs.

Flowers from June until September.

Jefferson (J. M. Coulter); Noble (Van Gorder); Tippecanoe (Cunningham); Floyd (Clapp); Hamilton (Wilson); Knox (Spillman); Vigo (Blatchley); Porter and Laporte.

C. LUPULIFORMIS Sartwell.

Reported only from the northern part of the State, where it is found sparingly in wet, low grounds about lakes and in rather cold bogs.

Flowers from June through August.

Shriner Lake (Deam).

C. UTRICULATA Boott. Bottle Sedge.

Reported from central and northern counties of the State as occurring in swamps and shaded lowlands.

Flowers from June through September.

Noble (Van Gorder); Hamilton (Wilson).

C. MONILE Tuckerm. Necklace Sedge.

Reported only from the swamp regions of the southwestern counties. The species is probably to be found throughout the State.

Flowers in June and July.

Gibson.

C. TUCKERMANI Dewey.

In marshes and low wet meadows in the southern counties. This species, originally sparingly found, has not been reported since 1887.

Flowers in June and July.

Floyd.

C. RETRORSA Schwein.

Reported from the swamp regions of the southwestern counties as occurring plentifully in many stations. The species probably occurs throughout the State in favorable locations.

Flowers in July and August.

Gibson.

C. LURIDA Wahl.

Widely distributed and abundant, growing in low, wet meadows or in marshes.

Flowers from June through September.

Noble (Van Gorder); Putnam (MacDougal); Vigo (Blatchley); Steuben (Bradner).

C. HYSTRICINA Muhl. Porcupine Sedge.

In low grounds in the northern counties in very wet soils, usually in open places.

Flowers in July and August.

Lake (Hill); Steuben (Bradner).

C. PSEUDO-CYPERUS L.

In cold bogs in the northern part of the State. Occurs sparingly in a few stations.

Flowers in June and July.

Noble (Van Gorder).

C. COMOSA Boott. Bristly Sedge.

(*C. Pseudo-Cyperus Americana* Hochst.)

Found throughout the State in low, wet grounds along streams and about the margins of ponds and lakes.

Flowers from May until the early frosts.

Shriner Lake (Deam); Floyd (Clapp); Noble (Van Gorder); Steuben (Bradner); Lake (Hill).

C. FRANKII Kunth. Frank's Sedge.

(*C. stenolepis* Torr.)

Found throughout the State in fair abundance, growing in low, wet meadows.

Flowers from June until September.

Tippecanoe (Cunningham); Jefferson (Barnes); Noble (Van Gorder); Marion.

C. SQUARROSA L.

Found widely distributed through the State and abundant in the stations in which it occurs. Grows in wet soils, usually in open places.

Flowers from June until October.

Floyd (Clapp); Jefferson (Barnes); Hamilton (Wilson); Vigo (Blatchley); Porter (Hill).

C. RIPARIA Curtis. Riverbank Sedge.

Exceptionally found in swamps in the northern counties of the State.

Flowers from May until September.

Steuben (Bradner); Lake (Hill).

C. SHORTIANA Dewey.

Reported from many stations, chiefly in the southern part of the State, growing in wet soils in either open or shaded places.

Flowers from May through August.

Davies (Clements); Jefferson (Barnes); Floyd (Clapp); Vigo (Blatchley).

C. LANUGINOSA Michx. Woolly Sedge.

Reported only from the southern counties of the State as occurring sparingly in wet meadows.

Flowers in June and July.

Jefferson.

C. FILIFORMIS L. Slender Sedge.

Reported from the extreme northern counties as of sparing occurrence in swamps and in low, bottom lands about lakes.

Flowers in June and July.

Lake (Hill).

C. FUSCA All. Brown Sedge.

(*C. Buxbaumii* Wahl.)

In bogs and wet places.

Flowering season from May to July.

Lake.

C. STRICTA Lam. Tussock Sedge.

Sparingly found in marshes and low, wet meadows. Probably not separated from *C. filiformis* in many cases.

Flowers from July through September.

Putnam (MacDougal).

C. TORTA Boott. Twisted Sedge.

Occasionally found in wet thickets and woods, but nowhere abundant.

Flowers in June and July.

Putnam (MacDougal).

C. CRINITA Lam. Fringed Sedge.

Found throughout the State in wet woods and thickets. Apparently occurring in greater abundance in the southern counties.

Flowers from May until September.

Davies (Clements); Putnam (MacDougal); Knox (Spillman); Vigo (Blatchley); Steuben (Bradner).

- C. **VIRESCENS** Muhl. Downy Green Sedge.
 Reported only from the southern counties, where it grows in dry, clay or sand soils in shaded places.
 Flowers from May until July.
 Jefferson and Porter.
- C. **TRICEPS** Michx. Hirsute Sedge.
 Found throughout the State, growing in moist soils, either in the shade or open. Nowhere abundant.
 Flowers from April until August.
- C. **GRACILLIMA** Schwein.
 Reported only from the southern part of the State, though probably of more general distribution. The species grows in moist, open woods and meadows.
 Flowers from May through July.
 Jefferson; Lake (Hill).
- C. **FORMOSA** Dewey. Handsome Sedge.
 In the central and northern counties of the State, growing in dry soil in shaded places.
 Flowers in June and July.
 Putnam (MacDougal).
- C. **DAVISII** Schwein. and Torr.
 Reported from the northern part of the State as occurring in moist woods. Not abundant.
 Flowers in June and July.
 Steuben (Bradner).
- C. **ARCTATA** Boott. Drooping Wood Sedge.
 Found in very sparing numbers in dry soil in shaded places. Reported only from the northern counties, but probably occurring throughout the State.
 Flowers in May and June.
 Steuben (Bradner).
- C. **TENUIS** Rudge.
 (*C. debilis Rudgei* Bailey.)
 Not uncommon throughout the State, growing in shaded places in rather dry soil.
 Flowers from May through August.
 Jefferson; Steuben (Bradner).

C. GRISEA Wahl. Gray Sedge.

Reported only from the southern counties, but doubtless occurring throughout our area. The species grows in shaded places in dry soil.

Flowers from May until August.

Jefferson (Barnes).

C. GRANULARIS Muhl. Meadow Sedge.

Found sparingly throughout the State, in moist meadows and on the borders of wet prairies.

Flowers from May through July.

Putnam (MacDougal); Vigo (Blatchley); Lake (Hill).

C. CRAWEI Dewey.

In damp, open places in the northern counties. Not abundant in any of its stations.

Flowers from May until July.

Lake (Hill).

C. FLAVA L.

In swamps and wet prairies in the northern part of the State. Probably of more general distribution than the reports indicate.

Flowers from July through September.

Noble (Barnes).

C. VIRIDULA Michx.

This extreme northern form is reported as occurring in Lake County, upon the authority of Rev. E. J. Hill. Probably not to be found in any other county except, perhaps, Porter.

Flowers in July and August.

C. CONOIDEA Schk. Field Sedge.

Throughout the central and northern counties, growing in meadows and abandoned fields in moist soils.

Flowers in May and June.

Putnam (MacDougal).

C. OLIGOCARPA Schk.

Found sparingly in all parts of the State, growing in dry soils in shaded places.

Flowers from May through July.

Putnam (MacDougal).

C. *HITCHCOCKIANA* Dewey.

In the central and northern counties, growing in woods and thickets in moist soils. Not abundant in any of its reported stations.

Flowers from May until August.

Noble (Van Gorder); Putnam (MacDougal).

C. *TETANICA* Schk. Wood's Sedge.

This northern and eastern form has obtained a place in our flora in the northwestern counties.

Added to the flora by Rev. E. J. Hill.

Flowers in June and July.

Lake (Hill).

C. *LAXIFLORA* Lam. Loose-flowered Sedge.

Throughout the State in open woods and borders of fields. Common in all of its stations.

Flowers from May until August.

Tippecanoe (Cunningham); Floyd (Clapp); Noble (Van Gorder); Vigo (Blatchley); Steuben (Bradner).

C. *LAXIFLORA BLANDA* (Dewey) Boot.

Reported only from the extreme southern and northern counties, but doubtless occurring throughout the State. The form grows in meadows and thickets in dry or moist soils.

Flowers from May through July.

Gibson and Lake.

C. *LAXIFLORA PATULIFOLIA* (Dewey) Carey.

Sparingly found in various counties of the State, associated with the two forms just preceding, from which it is probably not distinguished in many cases.

Flowers from May through July.

Jefferson; Putnam (MacDougal).

C. *STYLOFLEXA* Buckley. Bent Sedge.

(*C. laxiflora styloflexa* Boott.)

Reported only from the southern counties and probably not extending far northward in the State.

Flowers in May and June.

Jefferson.

C. *DIGITALIS* Willd.

In woods and thickets in the central and northern counties of the State. Frequently met, but nowhere abundant.

Flowers in June and July.

Tippecanoe (Cunningham).

C. CAREYANA Torr.

In rich woods in northern counties.

Flowering season from May until June.

Laporte.

C. ALBURSINA Sheldon. White Bear Sedge.

(*C. laxiflora latifolia* Boott.)

Found sparingly in the central and northern counties, growing in woods and thickets in moist soil.

Flowers in June and August.

Putnam (MacDougal); Laporte.

C. PLANTAGINEA Lam. Plantain-leaved Sedge.

Commonly found throughout the State in moist woods and thickets.

Flowers in June and July.

Tippecanoe (Cunningham); Jefferson (Barnes); Putnam (MacDougal); Steuben (Bradner); Laporte.

C. PLATYPHYLLA Carey. Broad-leaved Sedge.

Not uncommon in various parts of the State. Probably sparingly found throughout our area, in woods and thickets, in moist soils.

Flowers in May and June.

Hamilton and Marion (Wilson); Steuben (Bradner).

C. AUREA Nutt.

Reported only from the extreme northern counties, growing in wet, low grounds on the borders of swamps and sluggish streams.

Flowers in June and July.

Lake.

C. SETIFOLIA (Dewey) Britton. Bristle-leaved Sedge.

(*C. eburnea* Boott.)

Found in various parts of the State, in dry, sandy or rocky soils and upon limestone rocks.

Flowers in May and June.

Jefferson and Lake.

C. RICHARDSONI R. Br.

Apparently confined to the northern counties, where it grows in dry, sandy soil. Not abundant.

Flowers in June and July.

Lake (Hill).

C. PEDUNCULATA Muhl. Long-stalked Sedge.

The species is northern in its mass distribution, and its Indiana stations mark, perhaps, the southern limit of its range. Specimens I have examined leave no room for doubt as to its occurrence in our area. Found growing in dry, sandy soil. Confined to the northern counties.

Flowers in May and June.

Steuben (Bradner); Noble (Van Gorder).

C. PENNSYLVANICA Lam.

An early flowering form found sparingly in the State in dry soils.

Flowers in May and June.

Putnam (MacDougal); Steuben (Bradner).

C. VARIA Muhl.

Throughout the State in dry soils, but not abundant in any of its stations.

Flowers from May through July.

Jefferson and Lake.

C. UMBELLATA Schk.

Reported only from the northern part of the State as occasionally found in dry, sandy soils. Added to the flora by Rev. E. J. Hill.

Flowers from May through July.

Lake (Hill).

C. PUBESCENS Muhl. Pubescent Sedge.

Found throughout the central and northern counties in shaded places. It affects dry soil, but is not abundant in any of its stations.

Flowers in June and July.

Putnam (MacDougal); Hamilton (Wilson); Steuben (Bradner).

C. WILLDENOVII Schk.

Throughout the State in dry soils of thickets and woods. While not abundant, it is of fairly frequent occurrence.

Flowers in April and May.

Jefferson.

C. JAMESII Schwein.

Common in the central and northern counties, growing in dry soil in upland woods and thickets.

Flowers in April and May.

Tippecanoe (Cunningham); Noble (Van Gorder); Putnam (MacDougal).

C. LEPTALEA Wahl.

(C. *polytrichoides* Willd.)

Reported only from the northern counties as of occasional occurrence in bogs and swamps.

Flowers in June and July.

Noble (Van Gorder).

C. CONJUNCTA Boott. Soft Fox Sedge.

Found sparingly in the central and southern counties, growing in swampy woods and meadows.

Flowers from June until August.

Putnam (MacDougal); Vigo (Blatchley).

C. STIPATA Muhl. Awl-fruited Sedge.

Reported from the southern part of the State as common in low, wet grounds, usually in open places.

Flowers from May through July.

Vigo (Blatchley).

C. CRUS-CORVI Shuttlw. Raven's-foot Sedge.

Throughout the State in considerable abundance, growing in swamps or in very wet meadows. In the latter situation much reduced in size.

Flowers from May until July.

Tippecanoe (Cunningham).

C. TERETIUSCULA Gooden.

Not uncommon in the southern counties, growing in swamps and wet meadows. Not reported north of Putnam County.

Flowers in May and June.

Daviess (Clements); Lake (Hill).

C. ALOPECOIDEA Tuckerm. Foxtail Sedge.

A northern form reported from a few localities in the northern part of the State. Not of general occurrence.

Flowers in June and July.

Lake.

C. VULPINOIDEA Michx.

Common throughout the State in low, grassy places, usually in rather dry soils.

Flowers from May until July.

Tippecanoe (Cunningham); Putnam (MacDougal); Vigo (Blatchley).

C. SARTWELLII Dewey.

In the northern counties in swamps and low, wet grounds. Not especially abundant in any of its stations.

Flowers from May through July.

Lake.

C. TENELLA Schk. Soft-leaved Sedge.

In the central and northern counties in swamps and low, wet soils. Plentiful locally, but not of wide distribution.

Flowers in June and July.

Putnam (MacDougal).

C. ROSEA Schk. Stellate Sedge.

Frequently found in various counties of the State, growing in rich, moist soils in shaded positions.

Flowers in May and June.

Jefferson (Barnes); Putnam (MacDougal); Vigo (Blatchley).

C. MURICATA L. Lesser Prickly Sedge.

In the central and eastern counties, growing in open places in rather dry soils. Not frequent.

Flowers in June and July.

Putnam (MacDougal).

C. SPARGANIOIDES Muhl. Bur-reed Sedge.

Of common occurrence in many counties of the State, growing on borders of marshes and in low, damp woods and thickets.

Flowers from June through August.

Putnam (MacDougal); Vigo (Blatchley); Steuben (Bradner).

C. CEPHALOPHORA Muhl.

Quite frequent, especially in the southern counties, growing in dry soils in open places. It often extends into open woods.

Flowers in May and June.

Vigo (Blatchley).

C. MUHLENBERGII Schk.

Reported only from the northern counties in dry soils of fields and uplands. Probably to be found throughout our area.

Flowers in June and July.

Laporte (Barnes).

C. STERILIS Willd.*(C. echinata microstachys Boeckl.)*

In the northern counties, growing in moist, usually sandy soils.
Locally abundant. An extremely variable species.

Flowers from May through July.

Lake; Steuben (Bradner).

C. STERILIS CEPHALANTHA Bailey.*(C. echinata cephalantha Bailey.)*

Of the same range as the preceding, from which it is usually not separated.

Flowers from May through July.

Lake.

C. TRISPERMA Dewey.

In central and northern counties, growing in swamps and wet woods. Nowhere abundant.

Flowers from June through August.

Putnam (MacDougal).

C. BROMOIDES Schk.

In the central and northern counties, growing sparingly in bogs and extremely wet ground.

Flowers in June and July.

Putnam (MacDougal); Laporte.

C. MUSKINGUMENSIS Schwein. Muskingum Sedge.

In moist woods and thickets in the northern part of State.

Flowering season from June until August.

Lake (Hill).

C. TRIBULOIDES Wahl.

Throughout the State, usually found growing in low meadows along ditches. Not infrequent, but nowhere abundant.

Flowers from July through September.

Tippecanoe (Cunningham); Vigo (Blatchley); Jefferson.

C. SCOPARIA Schk.

Throughout the State, growing in low, wet soil. Usually abundant in the stations in which it occurs.

Laporte (Barnes); Vigo (Blatchley); Steuben (Bradner).

C. FOENEA Willd. Hay Sedge.

Reported only from the southern counties, but probably to be found throughout the State. Ordinarily found in dry soils in shaded places.

Flowers in May and June.
Gibson.

C. STRAMINEA Willd. Straw Sedge.

Found throughout the State, growing in dry soil in either open or shaded places. Common, but not abundant.

Flowers in June and July.
Vigo (Blatchley).

C. ALATA Torrey. Broad-winged Sedge.

Found only in the northern counties near the southern shores of Lake Michigan, growing in moist, rather sandy soils. Recognized as a member of the State flora by Rev. E. J. Hill.

Flowers in May and June.
Lake.

ARACEÆ. Arum Family.**ARISÆMA Mart.****A. TRIPHYLLUM (L.) Torr. Jack-in-the-Pulpit. Indian Turnip.**

In all parts of the State, in rich, moist soils in shaded localities.

Flowers from April through July.

Tippecanoe (Cunningham); Daviess (Clements); Fayette (Hessler); Decatur (Ballard); Putnam (MacDougal); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner); Jefferson (Barnes); Kosciusko (Coulter); Noble (Van Gorder); Cass (Hessler).

A. DRACONTIUM (L.) Schott. Green Dragon. Dragon-root.

Found throughout the State in situations similar to those in which the preceding species occurs, though perhaps more closely confined to moist shades. While of common occurrence, it is nowhere abundant. Easily distinguished from *A. triphyllum* by its many-segmented leaves.

Flowers in May and June.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (J. M. Coulter); Hamilton and Marion (Wilson); Fayette (Hessler); Vigo (Blatchley); Steuben (Bradner).

PELTANDRA Raf.

P. VIRGINICA (L.) Kunth. Green Arrow-arum.

In many counties of the State, but not abundant in any of its stations. It is found along large ditches, on the margins of ponds and the borders of swamps. Always in very wet soils or in shallow waters.

Flowers in May and June.

Vigo (Blatchley); Cass (Hessler); Steuben (Bradner); Gibson.

CALLA L.

C. PALUSTRIS L. Water Arum.

Reported only from the northern counties, where it is found sparingly in bogs and tamarack swamps.

Flowers in May and June; fruit ripens in August.

Noble (Van Gorder).

SPATHYEMA Raf.

S. FÆTIDA (L.) Raf. Skunk Cabbage.

(*Symplocarpus fetidus* Nutt.)

Quite common in all parts of the State, in swamps and rich, wet soils. A species of easy recognition.

Flowers very early, from February through April; fruit ripens in August and September.

Tippecanoe (Cunningham); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner); Franklin (Meyneke); Jefferson (J. M. Coulter); Noble (Van Gorder); Kosciusko (Coulter).

ACORUS L.

A. CALAMUS L. Sweet Flag. Calamus-root.

Of frequent occurrence throughout the State, growing in swamps and along streams, but abundant in none of its stations. More plentiful in the southern counties of the State. The large root stalks furnish the drug calamus.

Flowers in May and June.

Tippecanoe (Cunningham); Fayette (Hessler); Putnam (MacDougal); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner); Gibson, Cass (Hessler).

LEMNACEÆ. Duckweed Family.

SPIRODELA Schleid.

S. POLYRHIZA (L.) Schleid. Greater Duckweed.

Commonly found throughout the State in streams and shallow lakes. Very abundant in the pools of the low bottom lands about lakes.

No specimens in flower have been sent me, nor have I collected the species in flower.

Tippecanoe (Cunningham); Vermillion (Wright); Putnam (MacDougal); Hamilton and Marion (Wilson); Fayette (Hessler); Vigo (Blatchley); Steuben (Bradner); Cass (Hessler).

LEMNA L.

L. TRISULCA L. Ivy-leaved Duckweed. Star Duckweed.

In shallow pools about lakes, in ditches and sluggish streams throughout the State. Frequent, but ordinarily not abundant.

Flowers as early as May in the southern part of the State and continues until in August.

Hamilton (Wilson); Vigo (Blatchley); Steuben (Bradner); Kosciusko and Gibson.

L. MINOR L. Lesser Duckweed.

Quite abundant in shallow ponds and lakes and in sluggish streams in all parts of the State. In our area it apparently is most abundant in pools protected from long-continued, direct light.

Flowers from May until September.

Vigo (Blatchley); Noble (Van Gorder); Kosciusko and Tippecanoe.

WOLFFIA Horkel.

W. COLUMBIANA Karst.

Abundant in stagnant pools, about lakes and in shallow ponds throughout the State. This species, as minute alga-like grains, floats just beneath the surface of the water.

Flowers in June and July.

Vigo (Blatchley); Hamilton (Wilson); Steuben (Bradner); Kosciusko (Coulter).

W. BRASILIENSIS Wedd.

In similar situations as the preceding, but much less common, and apparently confined to the central and northern counties of the State. This species floats on the surface of the water.

Flowers in June and July.

Hamilton (Wilson).

XYRIDACEÆ. Yellow-eyed Grass Family.**XYRIS L.****X. FLEXUOSA** Muhl. Slender Yellow-eyed Grass.

Found in swamps and bogs in the northern counties of the State, and probably occurring sparingly throughout our area. While frequently met, it is abundant in none of its stations.

Flowers from July until September.

Laporte (Barnes); Lake (Hill); Kosciusko (Coulter).

ERIOCAULACEÆ Pipewort Family.**ERIOCAULON L.****E. SEPTANGULARE** With. Seven-angled Pipewort.

Found quite commonly in the northern counties in still waters and on muddy banks. When growing in the mud the weak scapes are from one to eight inches long; when submerged they vary in length from four to ten feet.

Flowers from July through October.

Laporte (Hill); Noble (Van Gorder); Steuben (Bradner); Round Lake (Deam).

COMMELINACEÆ. Spiderwort Family.**COMMELINA L.****C. NUDIFLORA** L. Creeping Day-flower.

Reported only from the southern counties as growing somewhat commonly along streams. The species probably extends but a short distance northward in the State.

Flowers in July and September.

Gibson and Posey (Schneck).

C. ERECTA L. Slender Day-flower.

In moist soils in the southern counties of the State. Admitted upon the authority of Dr. John M. Coulter. A southern form found only exceptionally in our area.

Flowers in August and September.
Jefferson (J. M. Coulter).

C. VIRGINICA L. Virginia Day-flower.

Throughout the State in moist soils, though found in greater abundance in the southern counties. It seems to affect soils with a considerable admixture of sand.

Flowers from June until September.

Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Vigo (Blatchley); Lake.

TRADESCANTIA L.

T. VIRGINIANA L. Spiderwort.

Found abundantly in all parts of the State, growing in rich, moist soils, usually in shaded situations. Extremely variable as to size, pubescence, leaf-shape and color of the flower. The differences are so great in some instances as to raise a question as to whether they should not be regarded as distinct species.

Flowers from May until September.

Tippecanoe (Cunningham); Daviess (Clements); Steuben (Bradner); Cass and Fayette (Hessler); Jefferson (Barnes); Vigo (Blatchley); Putnam (MacDougal); Franklin (Meyneke); Gibson and Posey (Schneck); Noble (Van Gorder); Clark (Baird and Taylor); Jay, Delaware, Randolph and Wayne (Phinney); Dearborn (Collins); Floyd (Clapp); Vermillion (Wright); Knox (Spillman); Decatur (Ballard); Hamilton and Marion (Wilson).

T. PILOSA Lehm.

Found in dry, gravelly banks or in drift soils in various parts of the State. Usually frequent in the stations in which it occurs.

Flowers from June through August.
Vigo (Blatchley); Cass (Hessler).

PONTEDERIACEÆ. Pickerel-weed Family.

PONTEDERIA L.

P. CORDATA L. Pickerel-weed.

Found in all parts of the State, but especially abundant in the lake regions of the northern counties, where it grows in the shallow waters of lake margins.

Flowers from June until October.

Tippecanoe (Cunningham); Laporte (Barnes); White (Hussey);
Vigo (Blatchley); Gibson and Posey (Schneck); Noble (Van
Gorder); Vermillion (Wright); Putnam (MacDougal); Shriner
Lake (Deam); Steuben (Bradner); Kosciusko and Marshall (Coulter).

HETERANTHERA R. and P.

H. RENIFORMIS R. and P. Mud Plantain.

Reported only from the southern counties, growing in shallow
waters and in mud. The species probably does not extend far
northward in our area.

Flowers in July and August.

Jefferson (J. M. Coulter); Gibson and Posey (Schneck).

H. DUBIA (Jacq.) MacM. Water Star-grass.

(*H. graminea* Vahl.)

Found throughout the State, growing in quiet water and also on
muddy banks. The form growing in the mud is much reduced in
size. Usually quite abundant in the stations in which it occurs.

Flowers from July through September.

Laporte (Barnes); Putnam (MacDougal); Noble (Van Gorder);
Gibson and Posey (Schneck); Fayette (Hessler); Vigo (Blatchley);
Kosciusko (Coulter).

JUNCACEÆ. Rush Family.

JUNCUS L.

J. EFFUSUS L. Common Rush. Bog Rush. Soft Rush.

Found throughout the State growing in swamps and moist places.
Abundant in all stations from which it is reported.

Flowers from May until in August.

Jefferson (Barnes); Noble (Van Gorder); Decatur (Ballard);
Lake (Hill); Vigo (Blatchley); Steuben (Bradner); Laporte.

J. BALTICUS Willd. Baltic Rush.

Confined to the southern shores of Lake Michigan. Added to the
State flora by Rev. E. J. Hill. A northern shore form, probably
not extending far inland in our area.

Flowering in July.

Lake (Hill).

J. TENUIS Willd. Slender Rush. Yard Rush.

Abundant throughout the State, growing in dry or moist soils. It is usually more abundant in damp situations.

Flowers from June through August.

Tippecanoe (Cunningham); Jefferson (Barnes); Noble (Van Gorder); Putnam (MacDougal); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

J. GREENEI Oakes and Tuckerm.

Found only in the north, where it occurs sparingly on the southern shores of Lake Michigan. The mass distribution of the species is near the sea coast. Contributed by Rev. E. J. Hill.

Flowers in June.

Lake (Hill).

J. DICHOTOMUS Ell. Forked Rush.

This species is admitted upon the authority of Dr. J. Schneck. I have seen no specimens, but as the collections of Dr. Schneck were passed upon by Dr. Gray, I do not feel justified in excluding the species. The form is of dry soils "near the coast" and its occurrence in our southwestern counties is difficult to understand.

Flowers in June.

Gibson (Schneck).

J. MARGINATUS Rostk. Grass-leaved Rush.

Reported from the southern counties as occurring sparingly in grassy, moist places along ditches and sluggish streams.

Flowering in May and June.

Vigo (Blatchley).

J. PELOCARPUS E. Meyer.

Found in the northern part of the State in moist soils, in either shaded or open places. Not abundant.

Flowers in July.

Laporte (Barnes).

J. RICHARDSONIANUS Schult.

Found in the northern counties growing in sandy soils about bogs and swamps. Recognized as a member of the State flora by Rev. E. J. Hill.

Flowers in June and July.

Lake (Hill).

J. NODOSUS L. Knotted Rush.

Found frequently in the northern counties, less frequently in the southern part of the State. Frequents swamps and moist, gravelly banks.

Flowers in July and August.

Noble (Van Gorder); Gibson (Schneck); Lake (Hill).

J. TORREYI Coville.

J. nodosus megacephalus Torr.)

In swamps and wet, sandy soils in the northern counties of the State. Usually associated with *J. nodosus*, from which it is not always separated.

Flowers in July and August.

Tippecanoe (Cunningham); Jasper (Barnes); Fayette (Hessler); Lake (Hill).

J. SCIRPOIDES Lam. Scirpus-like Rush.

Found throughout the State, growing in wet, sandy soils. Apparently in greater abundance in the northern part of the State.

Flowers in July and August.

Laporte (Hill); Jefferson.

J. BRACHYCEPHALUS (Engelm.) Buch.

(*J. Canadensis brachycephalus* Engelm.)

Found in the northern part of the State in considerable abundance. Usually not separated from *J. Canadensis*, with which it is often associated.

Flowers in August and September.

Laporte.

J. CANADENSIS J. Gay.

Commonly found throughout the State, but especially abundant in the northern counties.

Flowers in August and September.

Shriner Lake (Deam); Steuben (Bradner); Laporte (Hill).

J. ACUMINATUS Michx. Sharp-fruited Rush.

Found throughout the State in low, wet grounds; seems to grow more vigorously in sandy soils. Abundant in all of its stations.

Flowers in May and June.

Vigo (Blatchley).

J. ACUMINATUS DEBILIS (A. Gray) Engelm.

In wet sands on the margins of ponds and streams. Abundant in the stations in which it occurs.

Flowers in May and June.

Vigo (Blatchley).

JUNCOIDES Adans.

J. PILOSUM (L.) Kuntze. Hairy Wood-rush.

(*Luzula vernalis* DC.)

Reported as a member of the State flora by Dr. D. T. MacDougal. Verifying specimens in herbarium of DePauw University.

Putnam (MacDougal).

J. CAMPESTRE (L.) Kuntze. Common Wood-rush.

(*Luzula campestris* DC.)

Found plentifully in all parts of the State in open woods and other light shades.

Flowers in May.

Jefferson (Barnes); Fayette (Hessler); Putnam (MacDougal); Vigo (Blatchley); Steuben (Bradner).

MELANTHACEÆ. Bunch-flower Family.

TOFIELDIA Huds.

T. GLUTINOSA (Michx.) Pers.

Found in the bogs and marshes of the northern counties. Not reported as occurring south of Cass County. While frequently found it is nowhere abundant.

Flowers in May and June.

Noble (Van Gorder); Lake (Hill); Cass (Hessler); Steuben (Bradner).

CHAMÆLIRIUM Willd.

C. LUTEUM (L.) A. Gray. Blazing Star.

(*C. Carolinianum* Willd.)

Found in the most of the southern Counties growing in low grounds. Frequently met, but abundant in none of its stations. Apparently more vigorous in moist meadows, though also found in shaded localities.

Flowers in May and June.

STENANTHIUM Kunth.

S. GRAMINEUM (Ker.) Morong. Grass-leaved Stenanthium.
(*S. angustifolium* Gray.)

Found in dry soil in the southern counties, usually occurring on hills fronting the Ohio River. A southern form of limited distribution in the State.

Flowers in August and September.

MELANTHIUM L.

M. VIRGINICUM L. Bunch-flower.

In many parts of the State growing in marshes and wet woods. Nowhere abundant, but more frequent in the southern counties than in the northern.

Flowers in June and July.

Cass (Hessler); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Floyd and Harrison (Clapp).

VERATRUM L.

V. VIRIDE Ait. Indian Poke. American White Hellebore.

Sparingly found in many localities, growing in swamps and wet woods and thickets.

Flowers in May and June.

V. WOODII Robbins.

In central and southern counties growing in dry soils, usually on shaded slopes. Not plentiful in any of the stations in which it occurs.

Flowers in June and July.

Greene (Wood); Montgomery, Decatur (Shannon); Vigo, Monroe and Tippecanoe (Blatchley); Hamilton (Wilson).

UVULARIA L.

U. PERFOLIATA L. Perfoliate Bellwort.

In rich, moist soils of woods and thickets throughout the State. Usually plentiful in the stations in which it occurs.

Flowers in May and June.

Jefferson (J. M. Coulter); Franklin (Meyncke); Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler); Putnam (MacDougal).

U. GRANDIFLORA J. E. Smith. Large-flowered Bellwort.

In moist, shaded places, in rich soil throughout the State. Usually abundant in all of its stations.

Flowers from April through June.

Tippecanoe (Cunningham); Daviess (Clements); Franklin (Meyncke); Clark (Baird and Taylor); Jefferson (Barnes); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Monroe (Blatchley); Putnam (MacDougal); Dearborn (Collins); Knox (Spillman); Vigo (Blatchley); Hamilton and Marion (Wilson).

U. SESSILIFOLIA L.

(*Oakesia sessilifolia* S. Wats.)

Reported only from the southern counties, but doubtless of wider range in the State. It grows in moist woods and thickets, in rich soils, or in those containing much clay.

Flowers in May and June.

Jefferson (Barnes); Monroe (Blatchley); Clark (Baird and Taylor); Gibson and Posey (Schneck).

LILIACEÆ. Lily Family.

HEMEROCALLIS L.

H. FULVA L. Day Lily.

Escaped from cultivation in the southern counties and established in meadows and along streams.

Flowers in June and July.

Gibson and Posey (Schneck); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Vigo (Blatchley).

H. FLAVA L. The Yellow Day Lily.

Found escaped from cultivation in the southwest. It occurs at the edges of gardens or in abandoned flower plats.

Flowers in June and July.

Gibson.

ALLIUM L.

A. TRICOCCUM Ait. Wild Leek.

Throughout the State in rich soils in shaded places. Usually abundant where found, at times covering large areas to the practical exclusion of other plants.

Flowers in June and July.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Fountain (Wright); Fayette (Hessler); Hamilton (Wilson); Steuben (Bradner).

A. CERNUUM Roth. Nodding Wild Onion.

Found abundantly throughout the State growing on gravelly banks, limestone ledges and wet meadows. Varies in size with the soil. Very variable.

Flowers in July and August.

Cass (Hessler); St. Joseph and Jefferson (Barnes); Owen and Putnam (MacDougal); Franklin (Meyncke); Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Lake (Hill); Decatur (Ballard); Vigo (Blatchley); Steuben (Bradner).

A. STELLATUM Ker. Prairie Wild Onion.

This western form is reported from Kosciusko County by Mr. W. W. Chipman. Probably entered the State along railway lines.

Flowers in July and August.

A. VINEALE L. Wild Garlic. Field Garlic.

Found in fields in the central and southern counties. Quite abundant locally.

Flowers in June and July.

Tippecanoe (Cunningham); Franklin (Meyncke.)

A. CANADENSE L. Meadow Garlic.

Found throughout the State in moist soils, either in meadows or open woods. As a rule, quite common in its stations.

Monroe and Vigo (Blatchley); Putnam (MacDougal); Franklin (Meyncke); Clark (Baird and Taylor); Noble (Van Gorder); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Daviess (Clements); Cass (Hessler); Hamilton and Marion (Wilson).

NOTHOSCORDUM Kunth.

N. BIVALVE (L.) Britton. Yellow False Garlic.

(*N. striatum* Kunth.)

On sandy hillsides and gravelly banks in various counties. Not common in any of the stations in which it occurs.

Flowers from March through July.

Tippecanoe (Cunningham); Gibson and Posey (Schneck); Vigo (Blatchley).

LILIUM L.

L. PHILADELPHICUM L. Red Lily. Wood Lily.

Throughout the State in dry soil in woods and thickets. Is most vigorous in sand soils.

Flowers in June and July.

Cass (Hessler); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Noble (Van Gorder); Gibson and Posey (Schneck); Hamilton (Wilson).

L. CANADENSE L. Yellow Lily.

Throughout the State, usually in moist soils in open places. The color of perianth-segments varies from yellow to red.

Flowers in June and July.

Tippecanoe (Cunningham); Cass (Hessler); Vigo (Blatchley); Franklin (Meyncke); Noble (Van Gorder); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Vermillion (Wright); Fayette (Hessler); Kosciusko (Chipman); Steuben (Bradner); Carroll.

L. SUPERBUM L. Turk's-cap Lily.

Found throughout the State in marshes and damp meadows, but abundant in none of its stations. Of more frequent occurrence in the northern than in the southern counties.

Flowers in July and August.

St. Joseph and Laporte (Barnes); Gibson and Posey (Schneck); Noble (Van Gorder); Randolph (Phinney); Franklin (Meyncke); Steuben (Bradner).

ERYTHRONIUM L.

E. AMERICANUM Ker. Yellow Adder's-tongue.

Found abundantly in all parts of the State in rich, rather moist soil, in open woods or other light shades.

Flowers from March until late in May.

Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Franklin (Meyncke); Clark (Baird and Taylor); Gibson and Posey (Schneck); Noble (Van Gorder); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Tippecanoe (Cunningham); Fayette (Hessler); Decatur (Ballard); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

E. ALBIDUM Nutt. White Adder's-tongue.

Throughout the State in open woods and clearings in moist, rich soils. Plentiful, but not so abundant as the preceding species.

Flowers from March through May.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Vigo (Blatchley); Clark (Baird and Taylor); Dearborn (Collins); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

QUAMASIA Raf.

Q. HYACINTHINA (Raf.) Britton. Wild Hyacinth. Squills.

(*Camassia Fraseri* Torr.)

Along streams and in rich, moist soils in many parts of the State. The species, formerly quite plentiful, is rapidly becoming extinct. To the north it occurs in drift soils.

Flowers in April and May.

Tippecanoe (Cunningham); Daviess (Clements); Cass (Hessler); Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougall); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Clark (Baird and Taylor); Gibson and Posey (Schneck); Dearborn (Collins); Hamilton (Wilson).

ORNITHOGALUM L.

O. UMBELLATUM L. Star of Bethlehem.

In fields and meadows in the southern counties, and sparingly escaped from cultivation elsewhere in the State.

Flowers in May and June.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Decatur (Ballard); Vigo (Blatchley).

MUSCARI Mill.

M. BOTRYOIDES (L.) Mill. Grape Hyacinth.

Sparingly escaped from cultivation in the southern counties, along roadsides near gardens.

Flowers from April through June.

Jefferson (J. M. Coulter); Clark (Baird and Taylor).

ALETRIS L.

A. FARINOSA L. Star-grass. Colic-root.

In various parts of the State, growing in dry, sandy or gravelly soil. Quite scarce in all localities from which it is reported.

Flowers in May and June.

Cass (Hessler); White (Hussey); St. Joseph (Barnes); Lake and Vigo (Blatchley); Gibson and Posey (Schneck).

CONVALLARIACEÆ. Lily-of-the-Valley Family.

ASPARAGUS L.

A. OFFICINALIS L. Asparagus.

Escaped from cultivation in many parts of the State, and very persistent where it has obtained a foothold. Found frequently as an annoying weed in cemeteries, having been largely planted in such places in past years.

Flowers from May until in September.

Tippecanoe (Cunningham); Daviess (Clements); Putnam (MacDougall); Jefferson (Barnes); Franklin (Meyncke); Noble (Van Gorder); Clark (Baird and Taylor); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson).

VAGNERA Adans.

V. RACEMOSA (L.) Morong. Wild Spikenard.

(*Smilacina racemosa* Desf.)

Found abundantly in all parts of the State, growing in moist soils in woods or on shaded banks. The berries are aromatic.

Flowers in May and June.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougall); Monroe and Vigo (Blatchley); Franklin (Meyncke); Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Fayette (Hessler); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

V. STELLATA (L.) Morong. Star-flowered Solomon's Seal.

(*Smilacina stellata* Desf.)

In moist soils in shaded places, in various parts of the State. Found sparingly in all of its stations.

Flowers in May and June.

Jefferson (J. M. Coulter); Franklin (Meyncke); Noble (Van Gorder); Gibson and Posey (Schneck); Tippecanoe (Hussey); Hamilton (Wilson).

UNIFOLIUM Adans.

U. CANADENSE (Desf.) Greene. False Lily-of-the-Valley.

(Maianthemum Canadense Desf.)

Found in the northern counties of the State in damp, shaded places. A favorite situation for the form seems to be in tamarack swamps that have been partially dried through drainage.

Flowers in May and June.

Cass (Hessler); Noble (Van Gorder); Steuben (Bradner); Lake (Blatchley).

POLYGONATUM Adans.

P. BIFLORUM (Walt.) Ell. Hairy Solomon's Seal.

Found in all parts of the State growing in open woods and thickets. Usually abundant in the stations in which it occurs.

Flowers from April through July.

Daviess (Clements); Putnam (MacDougal); Jefferson (J. M. Coulter); Franklin (Meyneke); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

P. COMMUTATUM (R. and S.) Dietr. Smooth Solomon's Seal.

(P. giganteum Dietr.)

Very abundant in all parts of the State, growing on shaded banks and damp hillside thickets. Very variable in size and in leaf-form.

Flowers in May and June, continuing through July in the deeper shades.

Tippecanoe (Cunningham); Daviess (Clements); Monroe and Vigo (Blatchley); Putnam (MacDougal); Jefferson (J. M. Coulter); Franklin (Meyneke); Clark (Baird and Taylor); Dearborn (Collins); Noble (Van Gorder); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

CONVALLARIA L.

C. MAJALIS L. Lily-of-the-Valley.

Escaped from cultivation in many places and very persistent. As an escape it flowers very sparingly, sometimes not at all.

MEDEOLA L.

M. VIRGINIANA L. Indian Cucumber-root.

Found in many counties of the State in rich, moist soils of woods and thickets. Not abundant in any of its stations.

Flowers in May and June.

Jefferson (Barnes); Monroe (Blatchley); Putnam (MacDougal); Noble (Van Gorder); Fayette (Hessler); Steuben (Bradner); Lake.

TRILLIUM L.

T. SESSILE L. Sessile-flowered Wake-robin.

Common in rich moist soils of woods and thickets in all parts of the State. Flowers have a very pleasant odor.

Flowering season April and May.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Franklin (Meyncke); Clark (Baird and Taylor); Gibson and Posey (Schneck); Noble (Van Gorder); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Knox (Spillman); Fayette (Hessler); Decatur (Ballard); Vigo (Blatchley); Steuben (Bradner).

T. RECURVATUM Beck. Prairie Wake-robin.

Growing in woods and thickets in moist, rich soils. Very abundant in all of its stations.

Flowering season from April until June.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson and Cass (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Franklin (Meyncke); Clark (Baird and Taylor); Noble (Van Gorder); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Knox (Spillman); Decatur (Ballard); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

T. NIVALE Riddell. Early Wake-robin.

Found sparingly in various counties of the State, chiefly southern, growing in rich, damp woods and thickets.

Flowers from March through May.

Monroe (Blatchley); Putnam (MacDougal); Clark (Baird and Taylor); Decatur (Ballard); Tippecanoe.

T. GRANDIFLORUM (Michx.) Salisb. Large-flowered Wake-robin.

Occasionally found in rich woods, chiefly in the northern counties. Many forms so referred in herbaria are really *T. erectum* L.

Flowers in May and June.

Gibson and Posey (Schneck); Noble (Van Gorder); Steuben (Bradner).

T. ERECTUM L. Ill-scented Wake-robin.

Quite abundant in most parts of the State, growing in rich, moist soils in shaded places. Variable in size and especially in color of the flowers. The flowers have a very unpleasant odor.

Flowering season, April through June.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Franklin (Meyncke); Dearborn (Collins); Clark (Baird and Taylor); Noble (Van Gorder); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Knox (Spillman); Decatur (Ballard); Fayette (Hessler); Vigo (Blatchley); Hamilton (Wilson); Steuben (Bradner).

T. CERNUUM L. Nodding Wake-robin.

Found in moist, rich soils in shaded situations in various counties of the State, chiefly southern. Frequently confounded with pendulous forms of the preceding species.

Flowers from April through June.

Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Putnam (MacDougal); Vigo (Blatchley); Steuben (Bradner); Jefferson and Marion.

SMILACEÆ. Smilax Family.**SMILAX L.****S. HERBACEA L.** Carrion-flower.

Found throughout the State in rich, damp soils, usually in shaded situations. Abundant in all of its stations. The flowers are carrion scented.

Flowers from April through June.

Tippecanoe (Cunningham); Daviess (Clements); Monroe and Vigo (Blatchley); Putnam (MacDougal); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Vermillion (Wright); Fayette, Cass, (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

S. ECIRRHATA (Engelm.) S. Wats. Upright Smilax.

Sparingly found in dry soil along railroad embankments. Not of general distribution; possibly a migrant.

Flowers in May and June.

Hamilton (Wilson).

S. GLAUCA Walt. Glaucons-leaved Greenbrier.

In dry, sandy soil, reported only from the southern counties, but probably found throughout our area.

Flowers in May and June.

Vigo (Blatchley); Putnam (MacDougal); Jefferson (J. M. Coulter); Gibson and Posey (Schneck).

S. ROTUNDIFOLIA L. Greenbrier. Catbrier. Horsebrier.

In moist woods and borders of thickets, usually in rich soils. Pleasant in all parts of the State. The blue-black berries make the plant very attractive in the fall and early winter.

Flowers from April through June.

Tippecanoe (Cunningham); Putnam (MacDougal); Franklin (Meyncke); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Dearborn (Collins); Gibson and Posey (Schneck); Decatur (Ballard); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

S. HISPIDA Muhl. Hispid Greenbrier.

In various parts of the State, growing in rich, rather sandy soils in shaded places. Abundant in all of its stations.

Flowers from May through July.

Monroe and Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Putnam (MacDougal); Gibson and Marion.

S. PSEUDO-CHINA L. Long-stalked Greenbrier.

Reported only from the southern counties, as found sparingly in sandy hillside thickets. Probably to be found in favorable situations throughout the State.

Flowers from May through August.

Daviess (Clements); Floyd (Clapp); Putnam (MacDougal); Vigo (Blatchley).

S. LANCEOLATA L. Lance-leaved Greenbrier.

Found in dry thickets, near railroads in a single county. The form is southern and its occurrence in our area is to be regarded as exceptional.

Flowers from March until September.

Decatur (Ballard).

AMARYLLIDACEÆ. Amaryllis Family.

HYMENOCALLIS Salisb.

H. OCCIDENTALIS (Le Conte) Kunth.

A southern and western form which is found only in our extreme southwestern counties, where it grows sparingly in moist, rich soils.

Flowers in July and August.

Gibson and Posey (Schneck).

AGAVE L.

A. VIRGINICA L. False Aloe.

Found in the southern part of the State, growing in dry, usually sandy soils in upland or hill situations. Flowers pleasantly fragrant, retaining fragrance after drying for a considerable time.

Flowers in June and July.

Daviess (Clements); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Scott (Coulter).

HYPOXIS L.

H. HIRSA (L.) Coville. Star-grass.

(*H. erecta* L.)

Found in dry, usually sandy soils in all parts of the State. Usually quite plentiful in the stations in which it occurs.

Flowers from May until the early frosts.

Fayette (Hessler); Steuben (Bradner); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Franklin (Meyncke); Jefferson (J. M. Coulter); Noble (Van Gorder); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney).

DIOSCOREACEÆ. Yam Family.

DIOSCOREA L.

D. VILLOSA L. Wild Yam-root.

In damp, rich soils in shaded situations in many counties of the State, chiefly southern. The fruit which ripens in September is persistent through the winter.

Flowers in June and July.

Tippecanoe (Cunningham); Daviess (Clements); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner); Jefferson (J. M. Coulter).

IRIDACEÆ. Iris Family.

IRIS L.

I. VERSICOLOR L. Larger Blue Flag.

Throughout the State in marshes and low, wet places, usually in great abundance in all of its stations. One of our most showy marsh plants.

Flowers from May until in July.

Tippecanoe (Cunningham); Daviess (Clements); Clark and Jefferson (Barnes); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Noble (Van Gorder); Vermillion (Wright); Decatur (Ballard); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

I. CRISTATA Ait. Crested Dwarf Iris.

In the southern counties on hills and along streams. Sparingly found in its various stations. Most abundant perhaps in moist places in the knobs.

Flowers in April and May.

Clark (Baird and Taylor); Monroe (Blatchley).

GEMMINGIA Fabr.

G. CHINENSIS (L.) Kuntze. Blackberry-Lily.

(*Belamcanda Chinensis* Adans.)

Found in the southern counties along roadsides and upon hillsides.

Flowers in June and July.

Daviess (Clements); Frankliu (Meyneke); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Fayette (Hessler); Vigo (Blatchley).

SISYRINCHIUM L.

S. GRAMINOIDES Bicknell. Stout Blue-eyed Grass.

(*S. anceps* Cav.)

In grassy places in moist soils. Frequent, but nowhere abundant.

Flowers in April and May.

Decatur (Ballard).

S. ANGUSTIFOLIUM Mill. Blue-eyed Grass.

Abundantly found throughout the State in moist, grassy places, usually in open fields and meadows.

Flowers from May until September.

Tippecanoe (Cunningham); Daviess (Clements); Putnam (MacDougal); Clark and Jefferson (Barnes); Noble (Van Gorder); Franklin (Meyncke); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Knox (Spillman); Steuben (Bradner); Hamilton (Wilson); Fayette (Hessler); Vigo (Blatchley); Wabash (Jenkins).

ORCHIDACEÆ. Orchid Family.

CYPRIPEDIUM L.

C. ACAULE Ait. Moccasin Flower. Stemless Lady's Slipper.

Found only in the northern part of the State. It is of fair abundance in the stations in which it occurs. It is found in dry shaded places, but in our area is most abundant in dense tamarack swamps on coarse soiled knolls.

Flowers in May and June.

Cass (Hessler); Noble (Van Gorder); Fulton (Blatchley).

C. REGINÆ Walt. Showy Lady's Slipper.

(*C. spectabile* Salisb.)

Found in the northern counties in swamps and low grounds. Rare in all of its stations.

Flowers from June through September.

Noble (Van Gorder); Kosciusko (Chipman); Marshall (Hessler); Hamilton (Wilson); Lake and Porter; Steuben (Bradner).

C. CANDIDUM Willd. Small, White Lady's Slipper.

Found only in the extreme southwestern counties on the borders of swamps. Of very occasional occurrence.

Flowers in May and June.

Gibson and Posey (Schneck); Steuben (Bradner).

C. HIRSUTUM Mill. Large, Yellow Lady's Slipper.

(*C. pubescens* Willd.)

The most common species of the genus in the State. Found in many counties, growing in woods and thickets in rich, dry soil. Much more abundant than any other orchid.

Flowers in May and June.

Tippecanoe (Cunningham); Cass and Fayette (Hessler); Franklin (Meyncke); Noble (Van Gorder); Monroe and Vigo (Blatchley); Decatur (Ballard); Hamilton (Wilson); Steuben (Bradner).

C. PARVIFLORUM Salisb. Small, Yellow Lady's Slipper.

Found in a few counties in sparing numbers associated with *C. hirsutum*, with which it intergrades.

Flowers in May and June.

Gibson and Posey (Schneck); Dearborn (Collins); Noble (Van Gorder); Lake (Blatchley).

ORCHIS L.

O. SPECTABILIS L. Showy Orchis.

Throughout the State, growing in rich soils in woods or thickets. In some of its stations it is quite plentiful. In many respects one of the most attractive of the orchids. The flowers are pleasantly fragrant.

Flowering season, April and May.

Tippecanoe (Cunningham); Clark (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (Barnes); Dearborn (Collins); Noble (Van Gorder); Knox (Spillman); Hamilton (Wilson); Steuben (Bradner); Fayette (Hessler).

HABENARIA Willd.

H. ORBICULATA (Pursh) Torr. Round-leaved Orchis.

A form that has entered our flora from the north. It is found in the northern part of the State in rich, shaded soils in sparing numbers.

Flowers in July and August.

Noble (Van Gorder).

H. HOOKERIANA Gray.

(*H. Hookeri* Torr.)

In the northern parts of the State associated with the preceding species, from which it is not easily separable.

Flowers in July and August.

Noble (Van Gorder); Lake (Hill).

H. HYPERBOREA (L.) R. Br. Tall Leafy Green Orchis.

Occasional in swamps and wet woods in the extreme northern counties.

Flowers in May and June.

Lake (Hill); Porter.

H. BRACTEATA (Willd.) R. Br. Bracted Orchis.

In many counties of the State growing in open woods or upon hillsides, usually in thin, sandy soil. Not infrequent, but nowhere abundant.

Flowers from May through August.

Tippecanoe (Hussey); Noble (Van Gorder); Cass (Hessler); Kosciusko (Coulter); Vigo (Blatchley); Lake (Hill).

H. CLAVELLATA (Michx.) Spreng. Green Wood Orchis.

(*H. tridentata* Hook.)

Reported only from the north as of occasional occurrence in moist, shaded soils.

Flowering season July and August.

Lake (Hill).

H. FLAVA (L.) Gray.

(*H. virescens* Spreng.)

In damp, dense woods, in the southwestern part of the State. Of exceptional occurrence. Added to the State flora by Professor Blatchley.

Flowering specimens collected in June.

Vigo (Blatchley); Gibson; Steuben (Bradner).

H. CILIARIS (L.) R. Br. Yellow-fringed Orchis.

In the northern part of the State in moist, low grounds. Very occasional.

Flowers in July and August.

St. Joseph (Barnes); Tippecanoe (Noel); Steuben (Bradner).

H. LACERA (Michx.) R. Br. Ragged Orchis.

In peat bogs in the central and northern counties. Very exceptionally found.

Flowers in June and July.

Fulton (Hessler).

H. LEUCOPHĒA (Nutt.) Gray. White-fringed Prairie Orchis.

Moist soils in open places in the central and northern counties. Frequent.

Flowers in July and August.

White (Hussey); Noble (Van Gorder); Steuben (Bradner).

H. PSYCODES (L.) Gray. Purple-fringed Orchis.

Fairly distributed throughout the State, growing in moist soils either in woods or open places. Most frequently found in marshes.

Flowers in July and August.

Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Noble (Van Gorder); Steuben (Bradner).

H. PERAMCENA Gray. Fringeless Purple Orchis.

Quite plentiful in the southern counties in moist, open places. Flower fragrant.

Flowers in June and July.

Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Monroe and Vigo (Blatchley).

POGONIA Juss.

P. OPHIOGLOSSOIDES (L.) Ker. Rose Pogonia. Snake-mouth.

Somewhat abundant in the northern counties, growing in marshy places and peat bogs.

Flowers in June and July.

Noble (Van Gorder); Marshall (Hessler); Kosciusko (Coulter); Lake (Hill); Steuben (Bradner).

P. TRIANTHOPHORA (Sw.) B. S. P. Nodding Pogonia.

(*P. pendula* Lindl.)

Found throughout the State in rich soil, usually in woods or thickets. Frequent but not abundant.

Flowers in July and August.

Noble (Van Gorder); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Shriner Lake (Deam); Hamilton (Wilson); Fayette (Hessler); Lake; Steuben (Bradner).

P. VERTICILLATA (Willd.) Nutt. Whorled Pogonia.

Found sparingly in southern and south central counties in damp woods in rich soils.

Flowers in June and July.

Jefferson (Barnes); Monroe (Blatchley).

ARETHUSA L.

A. BULBOSA L.

This distinctly northern form is found in the northwestern part of the State, growing in marshes.

Flowering specimens collected May 19.

Lake.

GYROSTACHYS Pers.

G. PLANTAGINEA (Raf.) Britton. Wide-leaved Ladies' Tresses.
(*Spiranthes latifolia* Torr.)

In the central and northern counties on shaded banks and in woods in damp, rich soil.

Flowers from June until in August.

Tippecanoe (Hussey); Noble (Van Gorder).

G. CERNUA (L.) Kuntze.

(*Spiranthes cernua* Richard.)

Throughout the State, growing in marshes and low, wet meadow lands. Frequently met but nowhere abundant.

Flowers in August and September.

Cass (Hessler); Jefferson (Barnes); Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Noble (Van Gorder).

G. PRECOX (Walt.) Kuntze. Grass-leaved Ladies' Tresses.

(*Spiranthes precox* Walt.)

A sheet of rather scanty material seems referable to this species. The normal range is so far to the east that the reference is doubtfully made.

Collected in flower July 23.

Clark (Baird and Taylor); Steuben (Bradner).

G. GRACILIS (Bigel.) Kuntze. Slender Ladies' Tresses.

(*Spiranthes gracilis* Bigel.)

Not uncommon in many counties in dry soil, in light woods or open places.

Flowering season, August and September.

Tippecanoe (Hussey); Jefferson (Barnes); Franklin (Meyncke); Clark (Baird and Taylor); Noble (Van Gorder); Lake.

PERAMIUM Salisb.

P. PUBESCENS (Willd.) MacM. Downy Rattlesnake Plantain.

(*Goodyera pubescens* R. Br.)

Found sparingly in many counties of the State, usual in high, dry soil in shaded places. In greater abundance in the more northern counties.

Flowers in July and August.

Cass (Hessler); Monroe and Vigo (Blatchley); Noble (Van Gorder); Gibson (Schneck); Putnam (MacDougal); Lake (Hill).

ACHROANTHES Raf.

A. MONOPHYLLA (L.) Greene. White Adder's-mouth.

(Microstylis monophylla Lindl.)

In moist woods in the southern counties.

Flowers in July.

Floyd (Clapp).

A. UNIFOLIA (Michx.) Raf Green Adder's-tongue.

(Microstylis ophioglossoides Nutt.)

In dry soils throughout the State, in woods and thickets. Not of frequent occurrence.

Flowers from July until in September.

Vigo and Monroe (Blatchley); Noble (Van Gorder).

LEPTORCHIS Thouars.

L. LILIIFOLIA (L.) Kuntze. Large Twayblade.

(Liparis liliifolia Richard.)

Throughout the State in rich, moist soils, in open woods and thickets. While found in many localities it is abundant in none of its stations.

Flowers from May through July.

Vigo and Monroe (Blatchley); Clark (Barnes); Union and Putnam (MacDougal); Gibson and Posey (Schneck); Franklin (Meyncke); Fayette (Hessler); Jefferson.

L. LOESELII (L.) MacM. Fen Orchis.

(Liparis Loeselii Richard.)

In the northern counties of the State, growing sparingly in wet soils of hillsides and thickets. Also found in the springy or quaking ground about lakes.

Flowers from May until July.

Fulton (Blatchley); Cass (Hessler); Kosciusko (Chipman); Noble (Van Gorder); Lake (Hill).

CORALLORHIZA R. Br.

C. CORALLORHIZA (L.) Karst. Early Coral-root.

(C. innata R. Br.)

In the southern part of the State in dry, somewhat sandy soils in open woods.

Flowering season May and June.

Floyd (Clapp).

C. ODONTORHIZA (Willd.) Nutt. Small-flowered Coral-root.

In various counties, chiefly southern, growing in shaded places. Found in many localities, but never abundant.

Flowers in July and August.

Clark and Jefferson (Barnes); Monroe (Blatchley); Franklin (Meyneke); Gibson and Posey (Schneck); Round Lake (Deam); Fayette (Hessler); Steuben (Bradner).

C. MULTIFLORA Nutt. Large Coral-root.

Of exceptional occurrence in a few stations, growing in open woods and thickets.

Flowers in July and August.

Noble (Van Gorder); Jefferson; Steuben (Bradner).

TIPULARIA Nutt.

T. UNIFOLIA (Muhl.) B. S. P. Crane-fly Orchis.

(*T. discolor* Nutt.)

This local and rare species has been collected at Clifty Falls by Professor A. H. Young, of Hanover College. So far as I am able to determine, this is the only reference for the State.

Flowering specimens collected in July.

Jefferson (Young).

LIMODORUM L.

L. TUBEROSUM L. Grass-pink.

(*Calopogon pulchellus* R. Br.)

In various counties of the State in bogs and wet soils. Quite plentiful, as a rule, in the stations in which it occurs.

Flowers in June and July.

Cass (Hessler); St. Joseph (Barnes); Noble (Van Gorder); Gibson (Schneck); Lake (Hill); Steuben (Bradner).

HEXALECTRIS Raf.

H. APHYLLUS (Nutt.) Raf. Crested Coral-root.

In the southern part of the State in rich woods. So far as my records show it was first collected by Mr. W. S. Blatchley.

Flowers in August.

Crawford (Blatchley).

APLECTRUM Nutt.

- A. SPICATUM (Walt.) B. S. P. Putty root. Adam and Eve.
(*A. hyemale* Nutt.)

Frequent in many parts of the State, usually in rich, sandy soils in open woods; frequently, especially in the northern counties, growing plentifully in swamps. A very noticeable form in the early spring because of the abundant, large, elliptic leaves which have persisted through the winter.

Flowers in May and June.

Clark (Barnes); Putnam (MacDougal); Franklin (Meyncke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Vigo (Blatchley); Hamilton (Wilson); Tippecanoe; Steuben (Bradner); Fayette (Hessler).

Sub-class 2.

DICOTYLEDONES.

Series 1.

CHORIPETALÆ.

SAURURACEÆ. Lizard's-tail Family.

SAURURUS L.

- S. CERNUUS L. Lizard's-tail.

In wet, swampy places and along ditches and by the borders of ponds. Usually in shaded places in rich soils. In favorable situations I have seen it cover acres. A handsome plant with fragrant flowers.

Flowers from June through August.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (J. M. Coulter); Kosciusko (Coulter); Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Noble (Van Gorder); Clark (Baird and Taylor); Hamilton and Marion (Wilson); Steuben (Bradner); Marshall (Hessler).

JUGLANDACEÆ. Walnut Family.

JUGLANS L.

- J. NIGRA L. Black Walnut.

Originally distributed in great abundance throughout the State, but now pretty thoroughly removed because of its high commercial

value. Some considerable areas are still found, remote from means of transportation, in which it still abounds, and considerable care is being exercised in the conservation and protection of the second growth. The tree reaches a height of from 100 to 150 feet and a trunk diameter of from five to ten feet. It is found chiefly in rich bottom lands and on hillsides. Its great value suggests it as a suitable species for reforestation purposes. Its uses are too well known to need mention. Two well-marked varieties, recognized by lumbermen and nut-gatherers, exist in our area; they are not, however, considered as botanically distinct.

Flowers in April and May; nuts ripen after the heavier frosts.

Distribution general.

J. CINEREA L. Butternut. White Walnut.

Generally distributed throughout the State in fair abundance, except in the southwestern counties in which it occurs exceptionally. A tree from sixty to eighty feet in height and of a trunk diameter of from two to three feet. It grows chiefly in rich woodlands and reaches its greatest development along the Ohio River, where it occasionally reaches a height of one hundred and ten feet.

The wood is light and soft, not strong, easily worked, taking a beautiful polish. Used chiefly for interior finish, cabinet work, etc.

Flowers in April and May; fruit ripens with the frosts.

Distribution general.

HICORIA Raf.

H. PECAN (Marsh.) Britton. Pecan.

(*Carya olivæformis* Nutt.)

Found in southern and southwestern counties in considerable abundance and following the river courses in less numbers well to the north. It grows in bottom lands and alluvial soils. A tree from one hundred to one hundred and sixty feet in height and with a trunk diameter of from three to five feet.

The wood is heavy and hard, but brittle, and much less valuable than that of other hickories. It is used locally for wheel stock and fuel. Its sweet, edible nuts form an important article of commerce.

Flowers in April and May; fruit ripens in September and October.

Range indicated above.

H. MINIMA (Marsh.) Britton. Bitter-nut. Swamp Hickory.*(Carya amara Nutt.)*

Distributed sparingly in various parts of the State, but chiefly in the northern portions. Generally found on the borders of streams and swamps. A tree from sixty to eighty feet high, with a trunk diameter of from two to three feet.

The wood is heavy and tough, but checks in drying. Used extensively for hoops, ox yokes, etc., and locally for wheel stocks.

Flowers in May and June; nuts ripen in September and October.

Range as indicated.

H. OVATA (Mill.) Britton. Shell-bark or Shag-bark Hickory.*(Carya alba Nutt.)*

Well distributed throughout the State and in most regions in great abundance. It is found in its best development in rich soils, though often growing on sandy ridges. A large tree ranging from 80 to 100 feet in height, though occasionally reaching 125 to 150 feet, with a trunk diameter of from three to five feet.

The wood is very hard and strong, tough and flexible, the more valuable portion being the nearly white sap-wood. It is used in the manufacture of agricultural implements, carriages, ax handles, baskets, etc. Large quantities are used locally for wheel stock. The nuts form a valuable commercial product.

Flowers in May; nuts ripen in September and October.

Range general.

H. LACINIOSA (Michx. f.) Sarg. Big Shell-bark. King Nut.*(Carya sulcata Nutt.)*

This species is definitely reported from 36 counties, and is abundant in almost all of the southern counties. Dr. Ridgway reports it as "quite as abundant as *H. ovata* in lower Wabash district." This general distribution is of peculiar interest, since Professor Sargent, in Vol. IX, Tenth Census, p. 133, reports it as "Rare and local." It is found in moist, rich, usually alluvial soils. A tree from 80 to 100 feet in height, with a trunk diameter of from two to four feet.

The wood is of the same general character as that of *H. ovata* and is used for the same purposes.

Flowers in May; nuts ripen in September and October.

Distribution general.

H. ALBA (L.) Britton. Mocker-nut. White-heart Hickory.*(Carya tomentosa Nutt.)*

Common in the more southern counties of the State. Less frequent northward. Generally found in rich uplands, less commonly

in bottom lands. A tree ranging in height from 80 to 100 feet, with a trunk diameter of from two to four feet.

The wood is similar to that of *H. ovata* and is used for the same purposes.

Flowers in May and June; nuts ripen in October and November.
Range as indicated.

H. MICROCARPA (Nutt.) Britton. Small-fruited Hickory.

(*Carya microcarpa* Nutt.)

Found in rich woods throughout the central and southern counties in rich soils. Found associated with *H. ovata*, from which it is usually not separated. It can be distinguished from *H. ovata* by its rough, close bark; smaller ovate buds, and smaller, thin-husked fruit. A tree rarely exceeding 80 feet in height or a trunk diameter of three feet.

The hard, tough wood is of the same character as that of *H. ovata* and is used for the same purposes.

Flowers in May and June; nuts ripen in September and October.
Range as indicated.

H. GLABRA (Mill.) Britton. Pig-nut Hickory. Brown Hickory.

(*Carya porcina* Nutt.)

Commonly distributed throughout the State, though not frequent in the extreme southwestern counties. A tree from 80 to 100, exceptionally 120 feet in height, and with a trunk diameter of from three to five feet.

The wood is of the same character as that of *H. ovata* and is used for the same purposes. The species is usually found growing on dry hills.

Flowers in May and June; the bitter fruit ripens in October and November.

Range general.

MYRICACEÆ. Bayberry Family.

COMPTONIA Banks.

C. PEREGRINA (L.) Coulter. Sweet Fern.

(*Myrica asplenifolia* L.)

A northern form, confined to the extreme north part of the State, where it occurs in dry, sand soils, especially upon sand hills. No-where abundant.

Flowers in April and May.
Lake (Hill).

SALICACEÆ. Willow Family.

POPULUS L.

P. ALBA L. White or Silver-leaf Poplar.

This tree has escaped so widely from cultivation as to be considered a member of the State flora. It is found in yards and along roadsides, having sprung up from suckers of older trees. The species thrives well and grows rapidly as an escape. The wood is soft and light and of little use in manufactures.

Flowers in March and May.

Range is practically identical with the places in which it has been cultivated.

P. HETEROPHYLLA L. Swamp or Downy Poplar.

Found in the swamps and alluvial soils of the southwestern counties. A tree from eighty to ninety feet in height and of a trunk diameter of from two to two and one-half feet. Its wood is light, soft and not strong. The species, according to Dr. Ridgway, is much more abundant than any other species of the genus in Knox and Gibson counties.

Flowers in April and May.

Vigo (Blatchley); Gibson and Posey (Schneck); Knox (Ridgway); Hamilton (Doane).

P. GRANDIDENTATA Michx. Great-toothed Aspen or Poplar.

This species is not of large distribution in the State. It is found in rich woods and along the borders of streams and swamps.

The wood is light, soft and not strong, and is of little value save for paper pulp.

Flowers in April and May.

In addition to the citations the species is found sparingly along the lower stretches of the Wabash and its tributaries.

Gibson (Schneck); Knox (Ridgway).

P. TREMULOIDES Michx. American Aspen.

Fairly distributed throughout the State; common in the northern and central counties, somewhat rare in the southwest. Dr. Ridgway says: "I have never seen *P. tremuloides* in Knox or Gibson county, though it may occur." Dr. Schneck, however, reports it as rare in Gibson and Posey counties.

The wood is light and soft, neither strong nor durable. Largely manufactured into wood pulp, and in some localities used in turnery and for flooring. The species rarely exceed sixty feet in height, with a maximum trunk diameter of two feet.

Flowers in March and May.

Found in all of the central and northern counties, in dry or moist soils, and in the following southern counties :

Putnam (MacDougal); Decatur (Ballard); Vigo (Blatchley); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Hamilton and Marion (Wilson).

P. DELTOIDES Marsh. Cottonwood.

(*P. monilifera* Ait.)

Well distributed throughout the State, bordering on streams in low, wet soil. A large tree, from one hundred to one hundred and fifty feet in height, with a trunk diameter of from four to eight feet. Wood very liable to warp in drying; light and soft. Largely used in the manufacture of paper pulp, light packing cases, fence boards and fuel.

It is now being largely planted for ornament and shade, under the name of the Carolina Poplar. It has little to recommend it for this use save its rapid growth and handsome foliage. Apart from these features, it has almost every bad habit that a plant can possess.

Flowers in April and May.

Found practically in every county of the State, for which reason specific ranges are omitted.

SALIX L.**S. NIGRA Marsh. Black Willow.**

Found chiefly in the southern counties and entirely absent from some of the northern counties. A small tree, from forty to fifty feet high, with a trunk diameter rarely reaching two feet.

The wood is light, soft, and weak, and checks badly in drying. It has no economic value. The bark is tonic and astringent, and is a popular household febrifuge. Many fine trees of this species are to be found in the southern part of the State which can some day be utilized for lumber for special purposes.

Flowers in April and May.

Vigo (Blatchley); Gibson and Posey (Schneck); Knox (Ridgway); Jefferson (J. M. Coulter); Hamilton (Wilson); Steuben (Bradner).

S. NIGRA FALCATA (Pursh) Torr.

(*S. falcata* Pursh.)

On the banks of streams and ponds; less frequent than the type. Reported by Mr. W. S. Blatchley.

Flowering in May.

Vigo (Blatchley); Steuben (Bradner.)

S. LUCIDA Muhl. Shining Willow. Glossy Willow.

In the swamp regions of the extreme northern counties, so far as reports go. An extremely beautiful form that could scarcely have escaped notice if of any general occurrence. The species has evidently entered our flora from the north.

Flowers in April and May.

Lake (Hill); Hamilton (Wilson); Steuben (Bradner).

S. ALBA L. White Willow.

Fairly distributed in moist soils along streams and about dwellings. Probably escaped from cultivation.

Flowers in April and May.

Jefferson (J. M. Coulter); Putnam (MacDougal); Hamilton and Marion (Wilson); Vigo (Blatchley); Steuben (Bradner).

S. ALBA CÆRULEA (J. E. Smith) Koch.

(*S. caerulea* J. E. Smith.)

An evident escape from cultivation reported by Dr. D. T. MacDougal.

Flowers in April and May.

Putnam (MacDougal).

S. ALBA VITELLINA (L.) Koch. Golden Osier.

Throughout the State in moist soils, especially along streams.

Flowers from April to May.

S. PURPUREA L.

Escaped from cultivation and well established in the southern counties.

Flowering in April and May.

Jefferson (J. M. Coulter); Hamilton (Wilson).

S. FLUVIATILIS Nutt. Sandbar Willow. River-bank Willow.

(*S. longifolia* Muhl.)

In various parts of the State in wet, sandy soil, often forming dense clumps. A tree from 20 to 30 feet high, rarely exceeding a foot in trunk diameter.

The wood is light and soft and is of no economic value.

Flowers in April and May.

Tippecanoe (Cunningham); Putnam (MacDougal); Vigo (Blatchley); Jefferson (J. M. Coulter); Clark (Baird and Taylor).

S. HUMILIS Marsh. Prairie Willow.

Found in dry soil in open places, somewhat abundantly. A shrub ranging from two to eight feet in height.

Flowers in April and May.

Laporte (Barnes); Putnam (MacDougal); Vigo (Blatchley); Tippecanoe (Coulter); Hamilton (Wilson); Steuben (Bradner).

S. TRISTIS Ait. Dwarf Gray Willow. Sage Willow.

In dry soil throughout the State.

Flowers in March and April.

S. DISCOLOR Muhl. Pussy Willow. Glaucous Willow.

Generally distributed throughout the State, along streams and borders of swamps in low, wet soil. Rarely exceeding 20 feet in height and more frequently a shrub of from 10 to 15 feet. Wood soft and weak; of no economic value.

Flowers in March and April.

Tippecanoe (Cunningham); Jefferson (Barnes); Vigo (Blatchley); Kosciusko (Coulter); Clark (Baird and Taylor); Gibson and Posey (Schneck); Knox (Spillman); Hamilton (Wilson); Steuben (Bradner).

S. SERICEA Marsh. Silky Willow.

In marshes and along streams in the central part of the State. Not common where it occurs.

Flowers in May and June.

Decatur (Ballard); Hamilton (Wilson); Steuben (Bradner); Floyd (Clapp).

S. PETIOLARIS J. E. Smith. Slender Willow.

On low, moist, sandy banks in the southern part of the State. Added to the list by Mr. Blatchley. Only occasionally found.

Flowers in April and May.

Vigo (Blatchley).

S. CANDIDA Fluegge. Hoary Willow.

In the extreme northern part of the State in bogs and wet lands. Found rather abundantly in its stations.

Flowering in May.

Noble (Barnes); Lake (Hill); Steuben (Bradner).

S. CORDATA Muhl. Heart-leaved Willow.

In a few counties in rather sparing numbers, growing in low, moist soils. More abundant southward.

Flowers in April and May.

Putnam (MacDougal); Vigo (Blatchley); Tippecanoe (Coulter).

S. CORDATA ANGUSTATA (Pursh). Anders.

In wet soil in the northern part of the State.

Flowers from April to May.

Steuben (Bradner).

S. GLAUCOPHYLLA Bebb. Broad-leaved Willow.

Found only along the southern shores of Lake Michigan, where it forms an important and characteristic member of the flora of the sand dunes.

Flowers in April.

Lake (Hill); Porter (Cowles).

S. ADENOPHYLLA Hook. Furry Willow.

Another species confined to the shores of Lake Michigan, where it is found in sandy soil, chiefly on sand dunes.

Flowering in April and May.

Lake (Hill); Porter (Cowles).

S. MYRTILLOIDES L. Bog Willow.

In swamps and extremely wet soils in the central and northern counties. An erect, slender shrub from one to three feet high.

Flowers in April and May.

Tippecanoe (Cunningham); Lake (Hill).

The difficulty in the determination of the species of this genus has led to its being largely neglected by collectors. All of the species reported doubtless have a wider range than is indicated by the citations, but in the desire to have the record reliable no stations have been given unless specimens have been examined. The hybridizing of the willows is very general, and adds greatly to the difficulty of determining the material sent for examination. It is believed that the list as given above can be relied upon and will serve as a suggestion to future collectors to devote more care to this interesting genus.

BETULACEÆ. Birch Family.**CARPINUS** L.**C. CAROLINIANA** Walt. Water Beech. Blue Beech. American Hornbeam.

Commonly distributed throughout the State, along the borders of streams and swamps. A small tree, from 30 to 50 feet high, with a trunk diameter rarely exceeding 15 inches.

The wood is very heavy, strong, hard, tough and durable in contact with the soil. Susceptible of a high polish. Used for posts, levers, handles of tools, etc.

Flowers in April and May.

Found in almost every county of the State.

Tippecanoe (Laben and Conner); Putnam (MacDougal); Vigo (Blatchley); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Kosciusko (Coulter); Hamilton and Marion (Wilson); Steuben (Bradner).

OSTRYA Scop.

O. VIRGINIANA (Mill.) Willd. Ironwood. Leverwood. Hop-tree.

(*O. Virginica* Willd.)

Commonly distributed throughout the State, in fair abundance except in the southwestern counties, where it is reported as very rare. A small tree, with a maximum height of about 40 feet and a trunk diameter of from ten to twelve inches. Wood similar in character to that of the Water Beech and used for the same purposes. It is usually found on dry, sandy ridges, but occasionally on river banks.

Flowers in April and May.

Jefferson (J. M. Coulter); Putnam (MacDougal); Vigo (Blatchley); Tippecanoe and Kosciusko (Coulter); Clark (Baird and Taylor); Gibson and Posey (Schneck); Hamilton and Marion (Wilson); Steuben (Bradner).

CORYLUS L.

C. AMERICANA Walt. Hazel-nut.

Well distributed throughout the State and usually very abundant where it occurs. It frequently forms dense thickets to the practical exclusion of all other plant forms. In many counties it is so abundant that the nuts furnish a considerable market product. It grows usually in dry soils, but does well in moist, low grounds.

Flowers in March and April; nuts ripen in August, but are not really edible until after frosts.

Tippecanoe; Warren (Sutton); Putnam (MacDougal); Vigo (Blatchley); Kosciusko (Coulter); Floyd (Clapp); Noble (Van Gorder); Steuben (Bradner); Hamilton and Marion (Wilson).

BETULA L.

B. POPULIFOLIA Marsh. American White Birch.

This species occurs in Tippecanoe County, growing in moist soils along the Wabash River. It occurs in sparing numbers. A tree about 40 feet high and with a trunk diameter of from 12 to 15 inches. The wood is soft and weak, being of no special value.

Flowers in May.

Tippecanoe (Golden).

B. POPYRIFERA Marsh. Paper or Canoe Birch.

Found only in the extreme northern part of the State, where it is reported as occurring in sparing numbers by Rev. E. J. Hill. Normally it is a large tree of from 70 to 80 feet in height and with a trunk diameter of from two to three feet. In our area it is much reduced.

The wood is hard and strong, being largely used in the manufacture of spools, shoe-lasts and pegs, for wood pulp, etc.

Flowering in April and May.

Lake (Hill).

B. NIGRA L. River Birch. Red Birch.

Not abundant in the State and apparently confined to the southern counties, where it grows on the banks of streams and in low, wet grounds. A tall, slender tree reaching at times a height of nearly 100 feet, with a maximum trunk diameter of two and one-half feet.

The wood is hard and strong and is used for furniture and wooden ware.

Flowers in April and May.

Gibson (Schneck); Clark (Baird and Taylor); Putnam, Jackson, Martin, Vigo (Blatchley).

B. LENTA L. Cherry, Black or Sweet Birch.

In a few counties of the State in sparing numbers. The tree in its full development is from 60 to 80 feet high, with a trunk diameter of from three to four feet. In our area it is much reduced in size.

The wood is hard and strong and is used in the manufacture of furniture and in ship building. "The aromatic oil of the branches and foliage is distilled in quantities and is an important article of commerce." (Britton and Brown.)

Flowers in April and May.

Fulton (Hessler); Gibson (Schneck); Noble (Van Gorder); Steuben (Bradner).

B. PUMILA L. Low Birch.

Occasionally found growing in marshes and swamps in the northern part of the State. A shrub ranging from five to fifteen feet in height. Abundant specimens of the species have been collected by Dr. Robert Hessler.

Flowers in May and June.

Fulton (Hessler); Lake; Steuben (Bradner).

ALNUS Gaertn.

A. INCANA (L.) Willd. Speckled or Hoary Alder.

A small tree from twenty to twenty-five feet high, or oftener a branching shrub, found along borders of streams or swamps. Reported only from the northern counties on the authority of the State Catalogue.

Flowers in April and May.

Lake and Porter.

A. RUGOSA (DuRoi) K. Koch. Smooth Alder.

(*A. serrulata* Willd).

Distributed in fair numbers through the State except in the eastern and southeastern counties. A small tree or shrub growing in wet, marshy regions. A decoction of the bark is a popular remedy against blood impurities.

Flowers in March and April.

Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Tippecanoe and Kosciusko (Coulter); Noble (Van Gorder); Knox (Ridgway).

FAGACEÆ. Beech Family.

FAGUS L.

F. AMERICANA Sweet. Beech.

(*F. ferruginea* Ait.)

Commonly distributed throughout the State, though in greatest abundance and size in the southern counties. A large tree from 75 to 110 feet high and with a maximum trunk diameter of five feet.

The wood is very hard, tough and strong, but is difficult to season and liable to check in drying. It has a high value as a fuel and is largely used in the manufacture of chairs, shoe-lasts, plane stocks, handles, etc. It commonly grows in rich soils and is often the prevailing tree over wide areas.

Flowers in April and May.

The range is so general that specific localities are omitted.

CASTANEA Adans.

C. DENTATA (Marsh.) Borkh. Chestnut.

(*C. sativa Americana* Wats. and Coult.)

Found abundantly in some of the southern counties, especially in the region of the Knobs where it sometimes forms large groves. More sparingly found in other parts of the State, in most of the latter cases as an escape. It is indicative when growing in numbers of rich soil. A tree from 80 to 100 feet in height and with a trunk diameter of from six to thirteen feet.

The wood is light and soft, not strong, but durable in contact with the soil; it checks and warps badly in drying. Commonly used in cabinet-making, fencing, posts and railway ties. Its chief value, perhaps, lies in its fruit. Cultivated quite largely in lawns and parks.

Flowers in June and July; fruit ripens in September and October.

Decatur (Ballard); Clark, Floyd, Harrison, Posey, Crawford, Gibson, and Knox.

C. PUMILA (L.) Mill. Chinquapin.

In the southwestern part of the State, usually in dry soil. Not of especial abundance. A shrub or small tree. I have seen no specimens, but material was determined by Professor Sargent, and also by Dr. Robert Ridgway.

Flowers in June; fruit ripens in September.

Knox and Gibson counties; "Valley of lower Wabash River, Indiana" (Sargent).

QUERCUS L.

Q. RUBRA L. Red Oak.

Well distributed through the timbered regions of the State, though reported as not common in the central eastern counties. A large tree ranging in height from 80 to 100 feet, with a trunk diameter of from three to seven feet; exceptionally larger.

The wood is coarse-grained, hard and strong. Used extensively for clapboards, cooperage, in the manufacture of cheap grades of furniture, and for inside finish.

Flowers in May and June; acorns ripe in September and October.

As its range practically covers the State, specific stations are omitted.

Q. PALUSTRIS Du Roi. Swamp Oak. Pin Oak.

Well distributed especially in the southern counties of the State, becoming less frequent toward the north. Usually found along the borders of streams or in swamps in rich soil. A tree in our area of from 80 to 100 feet in height and of a diameter ranging from three to five feet.

The wood is coarse grained, hard and very strong and is somewhat used for shingles, clapboards and in cooperage.

Flowers in May and June; acorns ripen in September and October.

Range general, limited as indicated above. According to Rev. E. J. Hill the northern limit of the species is the southern shore of Lake Michigan. (Bot. Gaz., Vol. 26, pp. 53-57.)

Q. **TEXANA** Buckley. Texan Red Oak.

A tree very similar to *Q. rubra* and *Q. palustris*, from which it is usually not separated. It is found in Gibson, Posey and Knox counties and probably extends farther northward along the Wabash River. In its maximum development it is much larger than either of the preceding species.

The wood is hard, heavy and strong and used for the same purposes as the preceding forms.

Flowers in April and May; fruit ripens in September and October.

The form was first detected in the State by Dr. J. Schneck.

Q. **COCCINEA** Wang. Scarlet Oak.

Found throughout the State, but in much greater development both as to size and number in the southern counties. Not frequent in the northern part of the State and wanting in certain of the central-eastern counties. In our area the species reaches a height of from 80 to 140 feet and a trunk diameter of from two to four feet.

The wood is not distinguished commercially from that of the red oak and is used for the same purposes.

Flowers in May and June; acorns ripen in September and October.

Range sufficiently indicated above.

Q. **VELUTINA** Lam. Black Oak. Yellow-barked Oak.

(*Q. coccinea tinctoria* Gray.)

More largely distributed than *Q. coccinea*, which it somewhat resembles. It usually grows on moist or dry uplands associated with red and white oaks, various hickories and maples. A tree of about the same size as the scarlet oak.

The wood is heavy and strong, but not tough. As is the case in the majority of oaks, it checks badly in drying. Used for cooperage and in construction. The bark is rich in tannin and is largely used in tanning; and the inner bark, which is extremely bitter, furnishes a valuable yellow dye.

Flowers in May and June; acorns ripen in September and October.

Range sufficiently indicated above.

Q. **DIGITATA** (Marsh) Sudw. Spanish Oak.

(*Q. falcata* Michx.)

General, but by no means abundant, in the southern counties. Usually found in dry, gravelly soils. A tree ranging from 80 to 100 feet in height, with a maximum trunk diameter of six feet.

Wood very hard and strong, but not durable. Used for cooperage and construction, but most largely for fuel. The bark is rich in tannin and is used for tanning.

Flowers in May and June; acorns ripen in September and October.

Range sufficiently indicated.

Q. MARYLANDICA Moench. Black-Jack Oak. Barren Oak.

(*Q. nigra* L?)

Found in barrens north and south, ordinarily in dry soil. A familiar tree, from 40 to 50 feet in height, and rarely exceeding two feet in diameter.

The wood is very hard and strong, but not durable, and checks badly in drying. Of little value except for fuel.

Flowers in May and June; acorns ripen in October and November.

Distribution sufficiently indicated.

Q. PHELLOS L. Willow Oak.

Rare in rich, sandy soils, in the southwestern counties. A tree from 60 to 80 feet high, with a trunk diameter of from two to three feet.

The wood is heavy and strong, but not hard. It is used somewhat for wheels, clapboards and in construction.

Flowers in April and May; acorns ripen in September and October.

Found in Gibson, Posey and Knox counties.

Q. IMBRICARIA Michx. Shingle Oak. Laurel Oak. Peach-leaved Oak.

A species easily distinguished from the fact that it is the only oak within our area with entire leaves. The leaves are shining, lanceolate in shape, and somewhat resemble those of the Peach. In Vigo County the species is most commonly known as "Jack Oak." It is fairly distributed throughout the State in rich soils. A tree from 80 to 100 feet high and from two to three feet in diameter.

The wood is heavy and hard, but checks badly in drying. Used for clapboards and shingles, and highly valued as a fuel.

Flowers in April and May; acorns ripen in September and October.

Range, general.

Q. ALBA L. White Oak.

Common throughout the timbered regions of the State, in many parts constituting the larger part of the forests. One of the most valuable forest trees yet remaining in any numbers. The largest specimens have, of course, been removed, but many of merchantable size remain. The tree reaches a height of from 80 to 100 feet and a trunk diameter of from three to seven feet.

The wood is strong, heavy, tough and durable in contact with the soil. It is, however, liable to check unless carefully seasoned. The species is of the highest economic value, the wood being used for almost every conceivable purpose from ship building to basket making. The value of the form is rapidly increasing, and they should be carefully conserved by the land owner.

Flowers in May and June; acorns ripen in September and October.
Distribution general.

Q. LYRATA Walt. Swamp, Overcup or Post Oak.

In swamps and along streams. "Common, locally, in Knox and Gibson counties. *Unquestionably* this species." (Ridgway.)

A tree from 80 to 100 feet in height, with a diameter of from two to three feet, often growing in deep, and often submerged swamps.

The wood is of the same general character and is used for the same purposes as the white oak.

Flowers in April and May; acorns ripen in September.
Distribution as indicated.

Q. MACROCARPA Michx. Bur Oak. Overcup or Mossy-cup Oak.

Common throughout the State in lands of fair quality. Readily recognized by its rough, thick and shaggy bark and its profuse branching. A large tree 80 to 100, exceptionally 150 feet high, with a diameter of from four to eight feet.

The wood is heavy, hard, strong, tough and more durable in contact with the soil than that of other American oaks. Usually confounded with the less valuable *Q. alba* and employed for the same purposes. Used locally to a considerable extent for wheel stock.

Flowers in May and June; acorns ripen in September and October.
Distribution general.

Q. MINOR (Marsh) Sarg. Post or Iron Oak.

(*Q. stellata* Wang.)

Not common, but found in dry, sandy soil in the southern and southwestern counties. A tree rarely exceeding 80 feet in height or a diameter of four feet.

The wood is not so tough as that of *Q. alba*, but otherwise of similar character. Largely used for fencing and railroad ties, less commonly for carriage stock and in cooperage. By some considered the most durable timber for posts, whence its common name.

Flowers in May and June; acorns ripen in September and October.

Distribution as indicated above.

Q. PLATANOIDES (Lam.) Sudw. Swamp White Oak.
(*Q. bicolor* Willd.)

Well distributed in the State along the borders of streams and swamps, but not found in the central-eastern counties. A large tree, from 90 to 120 feet in height, with a trunk diameter of from four to eight feet.

The wood is heavy, hard, strong and tough, checking to some extent in drying. It is used for the same purposes as the white oak; locally to some extent for wheel stock.

Flowers in May and June; acorns ripen in September and October.

Distribution general in situations indicated.

Q. MICHAUXII Nutt. Basket Oak.

Found in low, wet alluvial soil, especially in the southwestern portion of the State. Dr. Ridgway reports it as common in Knox and Gibson counties; at times the prevailing species on limited areas. A tree about 100 feet high, with a trunk diameter ranging from four to seven feet.

The wood is easily split, very durable in contact with the soil, tough and strong. Used for agricultural implements, wheel stock, baskets, cooperage, fencing and construction. The large, sweet acorns are eagerly eaten by stock.

Flowers in April and May; fruit ripens in September and October.

Distribution as indicated above.

Q. PRINUS L. Rock Chestnut Oak.

This species was found by Miss Alida Cunningham in Tippecanoe County in 1896. The form was growing in dry soil, and the tree from which material was collected was about 80 feet in height, with a trunk diameter of a little more than two feet. So far as I am aware, the only record for the State.

Q. ACUMINATA (Michx.) Sarg. Yellow Oak. Chinquapin Oak.
(*Q. Muhlenbergii* Engelm.)

Well distributed throughout the State in rich soils. A tree from 80 to 100 feet in height, with a trunk diameter of from two to three feet. According to Mr. Blatchley, two marked varieties of the species occur in Vigo County. "In the one the leaves closely resemble those of the chestnut, being lanceolate, acuminate, sharply serrate, the veins very prominent; five and one-half inches long by one and three-fourths inches wide (average). In the other the

leaves are broadly ovate or obovate, seven inches long by five wide, the teeth rounded, the veins less prominent." The small acorns are sweet and edible.

The wood is very strong and durable in contact with the soil, but checks badly in drying. Used for cooperage, railroad ties, wheel-stock, fencing, etc.

Flowers in May and June; acorns ripen in October and November.

Range indicated.

ULMACEÆ. Elm Family.

ULMUS L.

U. AMERICANA L. American or White Elm. Water Elm.

Generally distributed throughout the State, and found in soils of every character, though reaching its greatest development in low, rich woods and along streams. A tree from 90 to 110 feet high, with a trunk diameter at times as great as eight or nine feet.

The wood is hard to split, but is strong and tough. It is used extensively for wheel stocks, saddle trees, flooring, in cooperage, and is now being largely exported to England for use in boat and ship building. The form is one of our most desirable shade trees either for lawns or streets. Its only disadvantage is, perhaps, its liability to injury from insects.

Flowering season, March and April.

Distribution so general that specific stations are omitted.

U. RACEMOSA Thomas. Cork or Rock Elm. Hickory Elm.

The distribution of this form is rather peculiar, so far as reports indicate. It is abundant in Franklin County and along the banks of the Ohio as far west as Jefferson County, but is not reported from any of the southwestern counties. It is found plentifully in Noble County, but in the central-eastern counties between Noble and Franklin it is apparently wanting. Sparingly found in other counties, usually in rich soils, though growing well in low, wet clay. A large tree, 60 to 90 feet high, often two or three feet in diameter.

The wood is hard, tough and strong, and susceptible of a high polish. It is largely used in the manufacture of heavy agricultural implements, for railway ties, bridge timbers, sills, etc., and is a form of high economic value.

Flowers in April.

Distribution indicated above.

U. ALATA Michx. Winged Elm. Wahoo.

A small tree, found in the southern and southwestern counties, usually in moist soils along streams. Occasionally it occurs in dry uplands. It is ordinarily rather sparingly found, though quite frequent in Crawford and Harrison counties.

The wood is compact and unwedgable, and is largely used for hubs, blocks, etc.

Flowering season, March and April.

U. FULVA Michx. Slippery or Red Elm.

Generally but sparingly distributed throughout the State. More abundant apparently in the southeastern counties than in other parts of the State. A tree, in our area, from 45 to 60 feet high and with a trunk diameter of from one and one-half to two feet.

Its wood is close-grained, compact and strong, and durable in contact with the soil. It splits readily when green. Largely used for wheel-stock, fence-posts, rails, railway ties, sills, etc. An infusion of the inner bark is a favorite household remedy. It grows most plentifully on the borders of streams and on hillsides in rich soils.

Flowers in March and April.

Distribution general.

PLANERA. J. F. Gmel.

P. AQUATICA (Walt.) J. F. Gmel. Water Elm.

In swamps and other extremely wet places in the central and southern parts of the State, but always in sparing numbers. It is not reported as occurring north of Putnam County. A small tree in our area, rarely exceeding 30 feet in height, with a trunk diameter of from one to one and one-half feet.

The wood is soft and weak and of no special economic value.

Flowering season, April and May.

Distribution indicated above.

CELTIS L.

C. OCCIDENTALIS L. Hackberry. Sugarberry.

Common throughout most of the State, but sparingly found in the central-eastern counties, and reduced in size in the northern counties. It is ordinarily found in open woods in dry soils, and particularly affects upper river terraces. A tree from 60 to 90 feet high, though exceptionally found from 110 to 115 feet (Ridgway), with a trunk diameter of from two to five feet.

The wood, while heavy, is soft and weak, and takes a fairly good polish. Used very largely for fencing and occasionally in the manufacture of cheaper grades of furniture.

Flowers in April and May.

Distribution indicated above.

C. *MISSISSIPPIENSIS* Bosc. Southern Hackberry.

A tree less common than the former and found in much more restricted area, being confined to the southern and southwestern counties. It is a tree similar to the preceding, though usually somewhat smaller. It is found in dry soil and seems to intergrade with *C. occidentalis* L.

The wood is of the same character and is used for the same purposes.

Flowers in April and May.

Distribution as indicated.

MORACEÆ. Mulberry Family.

MORUS L.

M. *RUBRA* L. Red Mulberry.

Generally distributed throughout the State, but not abundant in any locality. A tree from 50 to 60 feet high, with a trunk diameter of from three to five feet. It is generally found in rich bottom lands, though growing in reduced size in other locations.

The wood is not strong, but is rather tough and compact and of great durability in contact with the soil. It is largely used in fencing, cooperage and for snaths; in the South it is largely employed in boat and ship building.

Flowers in April and May; fruit ripening in June and July.

No better form could be planted to retain the birds in any given area.

Distribution as indicated.

M. *ALBA* L. White Mulberry.

Escaped from cultivation in the southern counties. Years ago large orchards of this species were planted in various southern counties for feeding silkworms. The industry did not thrive, but the trees have maintained themselves and have spread somewhat freely from their original stations.

Flowers in May; fruit ripens in July.

Found in all the southern counties to a greater or less extent and reported as far north as Putnam.

TOXYLON Raf.

T. POMIFERUM Raf. Osage Orange.

(Maclura aurantiaca Nutt.)

Used largely throughout the State for hedges and wind breaks and sparingly escaped in various counties. In our area the form rarely exceeds 30 or 40 feet in height and a trunk diameter of from one to one and one-half feet. It establishes itself strongly in rich soil, but becomes a straggling shrub in light thin soils.

The wood is hard, very strong, dense and durable.

Flowers in May and June; fruit ripens in October and November.

Tippecanoe (Thompson); Decatur (Ballard); Vigo (Blatchley); Jefferson (J. M. Coulter); Kosciusko (Coulter); Hamilton (Wilson).

HUMULUS L.

H. LUPULUS L. Hop.

Escaped from cultivation somewhat extensively in various parts of the State. Usually found in thickets along the banks of streams.

Flowers in June and July; fruit matures in September and October.

Tippecanoe (Cunningham); Vigo (Blatchley); Gibson and Posey (Schneck); Clark (Baird and Taylor); Jefferson (Barnes); Hamilton (Wilson); Steuben (Bradner).

CANNABIS L.

C. SATIVA L. Hemp.

In waste, rather dry places, in various counties. Abundant in places, but rarely troublesome. Of much wider range than citations indicate.

Flowers from July until September.

Tippecanoe (Cunningham); Putnam (MacDougal); Fayette (Hessler); Vigo (Blatchley); Jefferson (Barnes); Kosciusko (Coulter); Clark (Baird and Taylor); Hamilton and Marion (Wilson); Steuben (Bradner).

URTICACEÆ. Nettle Family.

URTICA L.

U. DIOICA L. Stinging or Great Nettle.

Rare, in waste places and by roadsides.

Flowers from July until September.

Marion.

U. GRACILIS Ait. Slender Nettle.

Found in various parts of the State growing in dry soil. Stinging hairs few in number.

Flowers from June through October.

Hamilton and Marion (Wilson); Fayette (Hessler); Vigo (Blatchley); Gibson and Posey (Schneck); Jefferson (Barnes); Kosciusko and Tippecanoe (Coulter); Steuben (Bradner).

URTICASTRUM Fabr.**U. DIVARICATUM (L.) Kuntze. Wood Nettle.**

(*Laportea Canadensis* Gaud.)

Throughout the State in rich soils, in moist, shaded places. Sometimes very abundant in low, dense woods. Thickly clothed with stinging hairs.

Flowers from July until September.

Hamilton and Marion (Wilson); Tippecanoe (Cunningham); Daviess (Clements); Fayette (Hessler); Putnam (MacDougal); Vigo (Blatchley); Jefferson (Barnes); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Kosciusko (Coulter); Steuben (Bradner).

ADICEA Raf.**A. PUMILA (L.) Raf. Clear Weed. Rich Weed.**

(*Pilea pumila* Gray.)

In all parts of the State, in shaded, rich soil, sometimes becoming annoying in lawns. It is usually abundant in its stations.

Flowers from July through September.

Hamilton (Wilson); Tippecanoe (Cunningham); Jefferson (Barnes); Putnam (MacDougal); Fayette (Hessler); Vigo (Blatchley); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Kosciusko (Coulter); Steuben (Bradner).

BOEHMERIA Jacq.**B. CYLINDRICA (L.) Willd. False Nettle.**

Throughout the State somewhat abundantly, growing in low, moist woods and on the borders of swamps.

Flowers from July until September.

Hamilton (Wilson); Daviess (Clements); Wayne (Plummer); Fayette (Hessler); Putnam (MacDougal); Vigo (Blatchley); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Kosciusko (Coulter); Tippecanoe (Hussey); Steuben (Bradner).

PARIETARIA L.

P. PENNSYLVANICA Muhl.

On shaded banks or in dry rocky places in various counties of the State. Of frequent occurrence, but nowhere abundant.

Flowers from June through August.

Daviess (Clements); Kosciusko (Chipman); Jefferson (Barnes); Hamilton and Marion (Wilson); Fayette (Hessler); Putnam (MacDougal); Gibson and Posey (Schneck); Tippecanoe (Coulter).

LORANTHACEÆ. Mistletoe Family.

PHORADENDRON Nutt.

P. FLAVESCENS (Pursh) Nutt. American Mistletoe.

Plentiful, especially in the southern part of the State, where it is parasitic on various deciduous trees. In our area it is found most frequently on the American Elm, Honey Locust and White Oak, in the order named. Farther south it is most frequently found on the Sycamore. I have never seen it in Indiana on either the Tulip Tree or Red Maple. Rapidly disappearing because of being gathered as a Christmas green.

Flowers in April; white berries still plump and smooth at Christmas.

Gibson and Posey (Schneck); Clark (Baird and Taylor); Jefferson (Barnes); Floyd (Clapp); Franklin (Meyncke); Dearborn (Collins); Bartholomew (Barnes); Crawford and Harrison.

SANTALACEÆ. Sandalwood Family.

COMANDRA Nutt.

C. UMBELLATA (L.) Nutt. Bastard Toad-flax.

General, in dry, sandy soil, in fields and thickets. It is frequently abundantly found in dry, virgin soils and upon exposed embankments.

Flowers from April through July.

Daviess (Clements); Cass (Hessler); Jefferson (Barnes); Franklin (Meyncke); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Gibson (Schneck); St. Joseph (Rothert); Monroe and Vigo (Blatchley); Kosciusko (Coulter); Clark (Baird and Taylor); Steuben (Bradner); Tippecanoe.

ARISTOLOCHIACEÆ. Birthwort Family.**ASARUM L.****A. CANADENSE L. Wild Ginger. Colt's Foot.**

Common throughout the State in shaded, hilly, rich woods, or along protected slopes. Usually in moist soil. An easily recognized form because of its narrow, heart-shaped leaves, brownish-purple flower, and the ginger flavor of its root.

Flowers in April and May.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneek); Noble (Van Gorder); Dearborn (Wilson); Franklin (Meynck); Putnam (MacDugal); Fayette (Hessler); Vigo (Blattley); Kosciusko (Conlert); Hamilton and Marion (Wilson); Steuben (Bradner).

ARISTOLOCHIA L.**A. SERPENTARIA L. Virginia Snake-root.**

Found throughout the State growing in loose, rich soil. Usually common in its stations.

Flowers in May and June.

Tippecanoe (Cunningham); Crawford (Barnes); Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneek); Fayette (Hessler); Jefferson and Marion; Steuben (Blattner); Monroe (Blattley).

A. TOMENTOSA Sims. Pipe Vine.

A distinctly southern form which has found its way into the flora of our southwestern counties. It is a twining vine, growing on rich river banks in considerable profusion in the regions indicated.

Flowers in May and June.

Gibson and Posey (Schneek); Knox (Wright).

POLYGONACEÆ. Buckwheat Family.**RUMEX L.****R. ACETOSELLA L. Field or Sheep Sorrel.**

Abundant throughout the State in barren or poor soil by roadsides and in old fields. In many parts of the State it has become a troublesome weed, taking complete possession of pasture lands and meadows. Very difficult to eradicate. Foliage very acid.

Flowers from May through September.

Tippecanoe (Cunningham); Daviess (Clements); Noble (Van Gorder); Dearborn (Collins); Gibson and Posey (Schneck); Franklin (Meyncke); Vermillion (Wright); Jefferson (J. M. Coulter); Putnam (MacDougal); Clark (Baird and Taylor); Fayette (Hessler); Knox (Spillman); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

R. VERTICILLATUS L. Swamp Dock.

In many parts of the State in wet soils, swamps and by the borders of marshes. Frequent in the stations in which it is found.

Flowers in May and June.

Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Cedar Lake (Deam); Knox (Spillman); Vigo (Blatchley); Hamilton and Marion (Wilson).

R. ALTISSIMUS Wood. Tall or Peach-leaved Dock.

Somewhat abundant in the central and southern counties of the State along streams and on the borders of ponds and ditches.

Flowers from April to June.

Jay, Delaware, Randolph and Wayne (Phinney); Dearborn (Collins); Fayette (Hessler); Vigo (Blatchley).

R. BRITANNICA L. Great Water Dock.

In many counties of the State in wet soils, along streams or in marshes. Abundant in the stations in which it is found.

Flowers in July and August.

Daviess (Clements); Tippecanoe (Hussey); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Franklin (Meyncke); Clark (Baird and Taylor); Noble (Van Gorder); Steuben (Bradner).

R. CRISPUS L. Curled Dock.

Common in all parts of the State, growing in waste and cultivated fields.

A troublesome and very persistent weed.

Flowers from May until August.

Tippecanoe (Cunningham); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Dearborn (Collins); Gibson and Posey (Schneck); Franklin (Meyncke); Clark (Baird and Taylor); Fayette (Hessler); Putnam (MacDougal); Knox (Spillman); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

R. CONGLOMERATUS Murr. Clustered or Smaller Green Dock.

In southern part of the State in waste places.

Flowers in May and July.

Jefferson.

R. SANGUINEUS L. Bloody or Red-veined Dock.

Rare, in waste places.

Flowers from May until August.

Gibson.

R. OBTUSIFOLIUS L. Bitter Dock.

Found throughout the State growing by roadsides and in waste places. Soon becoming plentiful where it obtains a foothold.

Flowers in June and July.

Tippecanoe (Cunningham); Jay, Delaware, Randolph and Wayne (Phinney); Franklin (Meyneke); Clark (Baird and Taylor); Dearborn (Collins); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Putnam (MacDougal); Fayette (Hessler); Vigo (Blatchley); Steuben (Bradner).

R. PERSICARIOIDES L. Golden Dock.

In sandy places. Reported but from one county.

Flowers from July to October.

Marion.

FAGOPYRUM Gaertn.**F. FAGOPYRUM (L.) Karst. Buckwheat.**

(*F. esculentum* Moench.)

In the borders of old fields and along roadsides in various parts of the State. It not only escapes from cultivation but is persistent after cultivation. Nowhere very abundant, but holding its own where it has obtained a foothold.

Flowers from June through August.

Franklin (Meyneke); Clark (Baird and Taylor); Noble (Van Gorder); Jefferson (Barnes); Gibson and Posey (Schneck); Vigo (Blatchley); Hamilton and Marion (Wilson).

POLYGONUM L.**P. AMPHIBIUM L. Water Smartweed.**

In many parts of the State in the shallow waters of ponds and lakes and sluggish streams. Common in the stations in which it is found.

Flowers in July and August.

Tippecanoe (Cunningham); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Vigo (Blatchley); Steuben (Bradner).

P. HARTWRIGHTII Gray. Hartwright's Persicaria.

In swamps and moist soil in northern part of the State.

Flowers from June until August.

Steuben (Bradner).

P. EMERSUM (Michx.) Britton. Swamp Smartweed.

(*P. Muhlenbergii* Watson.)

Abundant in the low lands about lakes and in swamps. Grows most vigorously in rich, sandy loams at the margins of ponds and marshes. Often confused with the preceding, which it greatly resembles.

Flowers from June until September.

Tippecanoe (Cunningham); Vigo (Blatchley); Kosciusko (Coulter); Lake; Hamilton (Wilson); Steuben (Bradner).

P. INCARNATUM Ell. Slender Pink Smartweed.

In wet soil throughout the State. Found in almost every collection, referred to *P. Pennsylvanicum*, from which it should be easily separated by the shape of the flowering spike and the absence of glands upon the peduncles and pedicels.

Flowers in June, continuing until late in September.

Fayette (Hessler); Round Lake (Deam); Putnam (MacDougal); Tippecanoe (Wright); Kosciusko (Coulter); Hamilton and Marion (Wilson); Steuben (Bradner).

P. LAPATHIFOLIUM L. Dock-leaved Smartweed.

Also widely distributed throughout the State, frequenting waste places in relatively dry soil. Confused in many collections with *P. Pennsylvanicum*. The varieties *nodosum* and *incana* are probably also found, but their intergrading with the type makes their separation extremely difficult.

Flowers from June until September.

Putnam (MacDougal); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Tippecanoe and Kosciusko (Coulter).

P. PENNSYLVANICUM L.

Very abundant in moist, even wet, rich soils in all parts of the State. Very variable as to size. In the rich muck soils, near the borders of some of our northern lakes, specimens have been collected over six feet in height, with widely spreading branches. Forms from four to five feet in height are not exceptional in such situations. The stems also become very hard and woody under such conditions, and the flowering spikes from two to four inches long.

Flowers from July until in October.

Tippecanoe (Cunningham); Daviess (Clement); Gibson and Posey (Schneck); Franklin (Meyneke); Noble (Van Gorder); Vermillion (Wright); Clark (Baird and Taylor); Jefferson (Barnes); Putnam (MacDougal); Hamilton (Wilson); Fayette (Hessler); Vigo (Blatchley); Kosciusko (Coulter); Steuben (Bradner).

P. PERSICARIA L. Lady's Thumb.

Frequent in waste places, usually in moist soils, in many parts of the State. In many cases it has become an annoying weed through its invasion of cultivated fields.

Flowers from June until the frosts.

Jay, Delaware, Randolph and Wayne (Phinney); Clark (Baird and Taylor); Noble (Van Gorder); Jefferson (J. M. Coulter); Putnam (MacDougal); Gibson and Posey (Schneck); Franklin (Meyneke); Fayette (Hessler); Vigo (Blatchley); Steuben (Bradner).

P. CAREYI Olney.

In swamps and marshes in a few localities in the northern counties. Nowhere abundant but not infrequent in the regions mentioned. First reported by Mr. W. B. Van Gorder.

Flowers in August and September.

Noble (Van Gorder); Kosciusko (Coulter); Marion.

P. HYDROPIPEROIDES Michx. Mild Smartweed.

In marshes and the shallow water of ponds and lakes and also on muddy shores, in many counties of the State. Common wherever found.

Flowers from June until September.

Tippecanoe (Cunningham); Jay, Delaware, Randolph and Wayne (Phinney); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Franklin (Meyneke); Clark (Baird and Taylor); Noble (Van Gorder); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

P. HYDROPIPER L. Smartweed. Water Pepper.

In wet, rich soils and along ditches and borders of ponds, in all parts of the State. Abundant in all of its stations.

Flowers from July until in October.

Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Franklin (Meyncke); Clark (Baird and Taylor); Noble (Van Gorder); Decatur and Shelby (Ballard); Putnam (MacDougal); Knox (Spillman); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

P. PUNCTATUM Ell. Water Smartweed.

(*P. acre* H. B. K.)

Widely distributed throughout the State in moist soils, chiefly in swamps and low grounds along waterways. Absent from extreme northern counties of the State.

Flowers from June until the heavy frosts.

Jay, Delaware, Randolph and Wayne (Phinney); Jefferson (Barnes); Putnam (MacDougal); Franklin (Meyncke); Clark (Baird and Taylor); Round Lake (Deam); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

P. ORIENTALE L. Prince's Feather.

In waste places about dwellings and along roadsides in many counties. The species has largely escaped from cultivation and maintains itself well, in some counties largely spreading.

Flowers in August and September.

Daviess (Clements); Clark (Baird and Taylor); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Jefferson (Barnes); Putnam (MacDougal); Franklin (Meyncke); Fayette (Hessler); Hamilton (Wilson); Steuben (Bradner); Gibson and Marion.

P. VIRGINIANUM L. Virginia Knotweed.

In heavily shaded places in damp, rich soil. Especially abundant in the heavy thickets of the undrained bottom lands about the margins of lakes. An easily recognized form.

Flowers from July through October.

Daviess (Clements); Gibson and Posey (Schneck); Jefferson (Barnes); Putnam (MacDougal); Noble (Van Gorder); Franklin (Meyncke); Fayette (Hessler); Hamilton (Wilson); Vigo (Blatchley); Steuben (Bradner).

P. AVICULARE L. Knot-grass. Doorweed.

A troublesome weed in lawns and along paths. Growing also abundantly along roadsides and in waste places, usually in dry, rather compact soil. Common in all parts of the State.

Flowers from June until November.

Tippecanoe (Cunningham); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Jefferson (Barnes); Putnam (MacDougal); Franklin (Meyneke); Clark (Baird and Taylor); Knox (Spillman); Fayette (Hessler); Vigo (Blatchley); Kosciusko (Coulter); Hamilton and Marion (Wilson); Steuben (Bradner).

P. ERECTUM L. Erect Knot-grass.

Widely distributed throughout the State, but not so abundant as the preceding. It grows about yards and along roadways, but is more abundant in moist, rather rich soils.

Flowers from July through September.

Tippecanoe (Cunningham); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Clark (Baird and Taylor); Vermillion (Wright); Gibson and Posey (Schneck); Jefferson (Barnes); Putnam (MacDougal); Franklin (Meyneke); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

P. RAMOSISSIMUM Michx. Bushy Knotweed.

In low, sandy soils in a few counties of the State. The northern station along the shore of Lake Michigan is a fairly natural one. It is barely possible that the plants from the southern station should be referred to the western form, *P. ramosissimum prolificum* Small.

Flowering in July and August.

Vigo (Blatchley); Lake (Hill); Porter (Cowles).

P. TENUE Michx. Slender Knotweed.

In rich, loose, dry soil in a few counties of the State, but nowhere abundant. Chiefly northern in its range in our territory.

Flowers from July through September.

Tippecanoe (Coulter); Lake (Hill); Vigo (Blatchley); Porter (Cowles).

P. CONVULVULUS L. Black Bindweed.

In all parts of the State in waste places and cultivated fields. In some few localities, where the soil is a rich, sandy loam, it has become a troublesome weed. Usually trailing, though frequently twining about low shrubs or fallen branches.

Flowers from June until September.

Tippecanoe (Cunningham); Jay, Delaware, Randolph and Wayne (Phinney); Putnam (MacDougal); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Kosciusko (Chipman); Vigo (Blatchley); Steuben (Bradner); Marion (Moffatt).

P. SCANDENS L. Climbing False Buckwheat.

(*P. dumetorum scandens* Gray.)

Abundant in all parts of the State, growing in moist woods and thickets. It covers bushes, brush heaps and fences in its vigorous growth in favorable localities. The vines frequently exceed 20 feet in length.

Flowers from July through September.

Daviess (Clements); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Jefferson (Barnes); Franklin (Meyncke); Putnam (MacDougal); Gibson and Posey (Schneck); Hamilton (Wilson); Vigo (Blatchley); Steuben (Bradner).

P. DUMETORUM L. Hedge Buckwheat.

This western form has entered the State along the line of east and west railways. Frequently not separated from the preceding, which it resembles.

Flowers from July to September.

Fayette (Hessler); Putnam (MacDougal); Hamilton and Marion (Wilson).

P. SAGITTATUM L. Arrow-leaved Tear-Thumb.

Widely distributed and very abundant, growing in low, wet places in rich soils. Either decumbent or climbing over other plants by the strong recurved prickles which arm the angles of the stem.

Flowers from July through September.

Tippecanoe (Cunningham); Cass (Hessler); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Vermillion (Wright); Jefferson (Barnes); Putnam (MacDougal); Gibson and Posey (Schneck); Franklin (Meyncke); Cedar Lake (Deam); Knox (Spillman); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

P. ARIFOLIUM L. Halberd-leaved Tear-Thumb.

First reported as occurring in the State by Mr. W. S. Blatchley. It grows in moist soils in ravines and along the borders of streams or marshes. Stem habit similar to the preceding, but the plant easily distinguishable because of its halberd-shaped leaves.

Vigo (Blatchley); Noble (Van Gorder); Clark (Baird and Taylor); Putnam (MacDougal); Steuben (Bradner).

POLYGONELLA Michx.**P. ARTICULATA (L.) Meisn. Coast Jointweed.**

Along the shores of Lake Michigan as a constituent member of the dune flora. The citation from Clark County by Baird and Taylor in their catalogue is doubtless an error.

Flowers July through September.

Lake (Hill); Porter (Cowles).

CHENOPODIACEÆ. Goosefoot Family.**CHENOPODIUM L.****C. ALBUM L. Pigweed. Lamb's Quarters. White Goosefoot.**

Abundant in all parts of the State in waste and cultivated grounds. A common and annoying weed in many places.

Flowering season from June until September.

Tippecanoe (Cunningham); Daviess (Clements); Jay, Delaware, Randolph and Wayne (Phinney); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); Putnam (MacDougal); Hamilton and Marion (Wilson); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

C. ALBUM VIRIDE (L.) Moq.

Occurring in similar localities as the type, from which it is scarcely distinguishable in many instances. Generally confused in local collections with *C. album*.

Flowers from June until September.

Putnam (MacDougal); Fayette (Hessler); Hamilton and Marion (Wilson); Tippecanoe (Coulter); Gibson (Schneck).

C. BOSCIANUM Moq.

In dry, sandy soil in open places, and also in woods and thickets. Not of especial abundance in any of its localities, but probably of wider range than the citations indicate.

Flowers from July until in September.

Vigo (Blatchley); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Tippecanoe (Coulter).

C. URBICUM L. Common or City Goosefoot.

Common in a few counties of the State, growing in waste places and along streets. Probably of much wider distribution than the references indicate.

Flowering season, June until September.

Clark (Baird and Taylor); Vigo (Blatchley); Marion; Steuben (Bradner); Tippecanoe.

C. HYBRIDUM L. Maple leaved Goosefoot.

Abundant and widely distributed in the State, growing in woods and thickets and at the borders of cultivated fields.

Flowers from June until September.

Clark (Baird and Taylor); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Kosciusko (Chipman); Vigo (Blatchley); Tippecanoe (Coulter); Marion; Steuben (Bradner).

C. BOTRYS L. Feather Geranium. Jerusalem Oak.

A common form, in many parts of the State growing in waste places and along the banks of waterways. "The leaves fall in the autumn, leaving the panicles as naked, narrow wands" (Britton and Brown).

Flowers from June until September.

Jefferson (Barnes); Franklin (Meyncke); Fayette (Hessler); Vigo (Blatchley); Tippecanoe (Coulter); Montgomery; Hamilton and Marion (Wilson); Steuben (Bradner).

C. AMBROSIODES L. Mexican Tea.

Confined apparently to the southern counties of the State, where it is quite common in waste places and in towns along streets and alleys.

Flowers from July through September.

Clark (Baird and Taylor); Jefferson (Barnes); Gibson and Posey (Schneck); Fayette (Hessler); Vigo (Blatchley).

C. ANTHELMINTICUM L. Wormseed.*(C. ambrosioides anthelminticum Gray.)*

Reported chiefly from the southern counties, but there quite abundant in waste places and about streets in towns. It is of less common occurrence than the preceding, with which it is often confused in local collections.

Flowers from July until October.

Clark (Baird and Taylor); Gibson and Posey (Schneck); Jefferson (Barnes); Vigo (Blatchley); Steuben (Bradner).

BLITUM L.**B. CAPITATUM L. Strawberry Blite.**

Occurs in dry soil in the northern counties.

Flowers from June to August.

Steuben (Bradner).

CORISPERMUM L.**C. HYSSOPIFOLIUM L. Bug-seed.**

Found only on the southern shore of Lake Michigan, where it is a character plant of the middle beach.

Flowers in August and September.

Lake (Hill); Porter (Cowles).

SALSOLA L.**S. TRAGUS L. Russian Thistle.***(S. Kali Tragus Moq.)*

This much dreaded weed has spread but little within our boundary since it obtained a footing some ten years ago. It is quite abundant in the northwestern corner of the State in the neighborhood of Chicago, where there is much uncultivated land. In the other counties in which it appeared, where the tillage of the soil is much closer, it has made no noticeable gain. The prompt recognition of its dangerous character doubtless served in a large measure to prevent its spread. While a certain amount of care will be needed for some time to come, the danger point, so far as this species is concerned, has passed.

Flowers from July until September.

Lake (Hill); Noble (Van Gorder); Wabash (Jenkins).

AMARANTHACEÆ. Amaranth Family.

AMARANTHUS L.

A. RETROFLEXUS L. Rough Pigweed.

Abundant throughout the State in waste places and cultivated fields. An annoying weed in many places, but yielding to careful cultivation of the soil.

Flowers from July until October.

Tippecanoe (Cunningham); Daviess (Clements); Clark (Baird and Taylor); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Putnam (MacDougal); Franklin (Meyncke); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

A. HYBRIDUS L. Slender Pigweed.

(*A. hypochondriacus* L.)

In the central and northern parts of the State, occurring quite plentifully in waste places. It is often confused with the preceding species in local collections.

Flowering in August and September.

Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Franklin (Meyncke); Fayette (Hessler); Tippecanoe (Coulter); Marion and Hamilton (Wilson); Steuben (Bradner).

A. HYBRIDUS PANICULATUS (L.) Uline and Bray.

(*A. paniculatus* L.)

Of similar range as the preceding, and in our area more abundant. It more frequently invades cultivated fields and is in consequence a more troublesome weed.

Flowers in August and September.

Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Noble (Van Gorder); Putnam (MacDougal); Kosciusko (Chipman); Vigo (Blatchley); Marion; Steuben (Bradner).

A. SPINOSUS L. Spiny Amaranth.

Confined apparently to the southern part of the State, where it is quite common in waste places and along roadsides. A very familiar form in the commons and vacant lots of towns. In some places an exceptionally troublesome weed.

Flowering season from June until late in September.

Clark (Baird and Taylor); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Daviess (Clements); Vigo (Blatchley); Hamilton and Marion (Wilson).

A. BLITOIDES S. Wats. Prostrate Amaranth.

In the northern part of the State, found almost exclusively along railways. The form often covers large areas.

Flowering season from June until October.

Round Lake (Deam); Lake and Porter (Hill); Hamilton and Marion (Wilson).

A. GRAECIZANS L. Tumbleweed. White Amaranth.

(*A. album* L.)

Widely distributed throughout the State and abundant wherever found. In waste places and cultivated fields. An exceedingly troublesome weed.

Flowers from June until October.

Jasper (Barnes); Kosciusko (Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Daviess (Clements); Tippecanoe (Cunningham); Vigo (Blatchley); Steuben (Bradner); Marion (Moffat); Jefferson.

ACNIDA L.

A. TAMARISCINA (Nutt.) Wood. Water Hemp.

(*A. tuberculata* Moq.)

In various counties of the State, chiefly southern, in wet, sandy and gravelly banks. Rather common in stations in which it occurs.

Flowers in July and August.

Tippecanoe (Cunningham); Vigo (Blatchley); Clark (Baird and Taylor); Gibson and Posey (Schneck); Fayette (Hessler).

A. TAMARISCINA TUBERCULATA (Moq.) Uline and Bray.

(*A. tuberculata subnuda* Wats.)

The borders of ponds in wet, sandy soils. Not as a rule separated from the preceding.

Flowers in July and August.

Vigo (Blatchley).

A. TAMARISCINA CONCATENATA (Moq.) Uline and Bray.

Also occurs in our area, but not ordinarily separated from the type. In drier soils.

Flowering in July and August.

Fayette (Hessler).

IRISINE P. Br.**I. PANICULATA (L.) Kuntze. Blood-leaf.**

In the southern counties, growing in dry soil. Quite frequent in the stations in which it occurs.

Flowers in August and September.

Clark (Baird and Taylor); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Floyd (Clapp).

PHYTOLACCACEÆ. Pokeweed Family.**PHYTOLACCA L.****P. DECANDRA L. Pokeweed. Pokeberry.**

A well-known tall herb of general occurrence throughout the State. The plant has a strong, unpleasant odor and the large root is poisonous. The early leaves are sometimes used for "greens."

Flowers from June until September.

Tippecanoe (Cunningham); Daviess (Clements); Putnam (MacDougal); Dearborn (Collins); Clark (Baird and Taylor); Franklin (Meyncke); Jefferson (Barnes); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Vigo (Blatchley); Floyd (Danser); Hamilton and Marion (Wilson); Steuben (Bradner).

NYCTAGINACEÆ. Four-o'clock Family.**ALLIONIA Loeft.****A. NYCTAGINEA Michx. Heart-leaved Umbrellawort.**

In central counties, growing in dry soil. First recognized as a member of the State flora by Dr. L. M. Underwood, formerly of DePauw University.

Flowers from June until August.

Hamilton (Wilson); Putnam (Underwood).

AIZOACEÆ. Carpet-weed Family.**MOLLUGO L.****M. VERTICILLATA L. Carpet Weed.**

In many counties of the State, and abundant wherever found. Frequent in bare, sandy places and in cultivated fields. In some localities an annoying weed.

Flowers from May until after the heaviest frosts.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Monroe and Vigo (Blatchley); Fayette (Hessler); Putnam (MacDougal); Hamilton and Marion (Wilson); Steuben (Bradner).

PORTULACACEÆ. Purslane Family.**TALINUM Adans.****T. TERETIFOLIUM Pursh. Farns-flower.**

From Lake County upon the authority of Rev. E. J. Hill. The distribution of the plant is such that it may be looked for in other parts of the State. It is usually found growing on dry rocks.

Flowering season from May until September.

CLAYTONIA L.**C. VIRGINICA L. Spring Beauty.**

Very abundant throughout the State, usually in moist, rich soils in woods and ravines. An extremely variable form, both as to color and markings of flowers and breadth of leaves. Various forms labelled *C. Caroliniana* have been referred to this species.

Flowers from early in March until in May.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Kosciusko (Chipman); Daviess (Clements); Decatur and Shelby (Ballard); Knox (Spillman); Hamilton and Marion (Wilson).

C. CAROLINIANA Michx.

In my judgment this species does not occur within our area. It has been reported from the southern counties by various botanists, who certify to its occurrence associated with the preceding species. It is therefore admitted tentatively.

Flowering season from March until April.

Distribution not given specifically, being noted merely as "occurring in southern counties."

PORTULACA L.

P. OLERACEA L. Purslane. Hog-weed.

Common in the southern counties of the State in gardens and cultivated grounds, often becoming a very annoying and persistent weed. Well known in the regions in which it is found.

Flowers from May until September.

Monroe and Vigo (Blatchley); Fayette (Hessler); Gibson and Posey (Schneck); Putnam (MacDougal); Hamilton and Marion (Wilson); Steuben (Bradner).

P. GRANDIFLORA Hook. Sun-plant.

Escaped from gardens in various parts of the State. Found usually in waste places near old gardens.

Flowering season from June until September.

CARYOPHYLLACEÆ. Pink Family.

AGROSTEMMA L.

A. GITHAGO L. Corn Cockle. Corn Campion.

(*Lychnis Githago Scop.*)

A very troublesome weed in cultivated fields, especially among cereals. Entirely too common in most parts of the State. Also found along railways.

Flowers from July until September.

Tippecanoe (Cunningham); Jefferson (Barnes); Putnam (MacDougal); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Daviess (Clements); Dearborn (Collins); Clark (Baird and Taylor); Franklin (Meyncke); Vermillion (Wright); Fayette (Hessler); Monroe and Vigo (Blatchley); Decatur and Shelby (Ballard); St. Joseph (Rothert); Hamilton and Marion (Wilson); Steuben (Bradner).

SILENE L.

S. STELLATA (L.) Ait. Starry Campion.

In woods and ravines or other shady places, also occurring sparingly in open fields. It is most abundant in sandy soils in damp places. More abundant in the northern counties of the State.

Flowering season from June until August.

Laporte (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (J. M. Coulter); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyneke); Clark (Baird and Taylor); Vermillion (Wright); Round Lake (Deam); Hamilton and Marion (Wilson); Steuben (Bradner).

S. ALBA Muhl. White Campion.

(*S. nivea* Oth.)

In shaded, moist places or along railroads in the southern counties. Not abundant in any of its stations.

Flowering in June and July.

Putnam and Vigo (Blatchley); Jefferson (J. M. Coulter); Jay, Delaware, Randolph and Wayne (Phinney); Clark (Baird and Taylor); Fayette (Hessler); Putnam; Hamilton and Marion (Wilson); Carroll.

S. VIRGINICA L. Fire Pink.

Frequent in shaded ravines and damp woods in most parts of the State. Rarely found in dry soils.

Flowers from April until September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Dearborn (Collins); Clark (Baird and Taylor); Franklin (Meyneke); Vermillion (Wright); Monroe and Vigo (Blatchley); Fayette (Hessler); Decatur (Ballard); Hamilton and Marion (Wilson).

S. REGIA Sims. Royal Catchfly.

Only occasionally found in a few counties of the State. It is found on the borders of prairies or open stretches in dry, rather sandy soil.

Flowers collected in June.

Vigo (Blatchley); Wayne (Phinney); Hamilton (Wilson); Gibson.

S. CAROLINIANA Walt. Wild Pink.

(*S. Pennsylvania* Michx.)

In various parts of the State, growing in dry, sandy or rocky soil. Not uncommon but abundant in none of its stations.

Flowers from April through June.

Tippecanoe and Jefferson.

S. ANTIRRHINA L. Sleepy Catchfly.

Common throughout the southern part of the State, less common in the northern. It grows in waste places in rather poor soils, and is also of frequent occurrence in fields among cereals.

Flowers from April until September.

Monroe and Vigo (Blatchley); Fayette (Hessler); Gibson and Posey (Schneck); Franklin (Meyncke); Clark (Baird and Taylor); Jefferson (Barnes); Tippecanoe (Cunningham); Daviess (Clements); Knox (Spillman); Hamilton and Marion (Wilson).

S. ARMERIA L. Sweet William.

In waste places in southwestern counties, probably as an escape from gardens. Found in waste places and abandoned gardens.

Flowering in June and July.

Gibson and Posey (Schneck).

S. NOCTIFLORA L. Night-flowering Catchfly.

In waste places in rather dry, sandy soils in a few counties. The flowers open at twilight, remain open through the night and are closed through the day. Its name arises from this habit.

Flowers from late in July until late in September.

Jefferson (Barnes); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Steuben (Bradner).

LYCHNIS L.**L. ALBA Mill. White Campion.**

(*L. vespertina* Sibth.)

Reported definitely but from one locality, in dry, rather coarse soil. The plants had been determined as *Silene noctiflora*, but a re-examination showed the five styles of *Lychnis*. It probably will be found in many counties.

Collected in flower July 29.

Tippecanoe (Cunningham).

SAPONARIA L.**S. OFFICINALIS L. Bouncing Bet. Hedge Pink.**

Commonly escaped throughout the State, growing in waste places and along roadsides. Frequently the prevailing plant over wide areas. In some instances it has become an annoying weed. Usually in sandy soils.

Flowering from June through September.

Tippecanoe (Cunningham); Daviess (Clements); Putnam (MacDougal); Jefferson (J. M. Coulter); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Dearborn (Collins); Clark (Baird and Taylor); Franklin (Meyncke); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

VACCARIA Medic.

V. VACCARIA (L.) Britton. Cow Weed.

(*Saponaria Vaccaria* L.)

In sandy, waste places and along roadsides in the central part of the State.

Flowers from June through August.

Putnam (MacDougal); Tippecanoe (Laben and Conner); Fayette and Marion (Hessler); Jefferson and Lake.

ALSINE L.

A. MEDIA L. Common Chickweed.

(*Stellaria media* Cyr.)

Abundant throughout the State, usually growing in rich, damp soils. Occasionally annoying in lawns.

Flowering begins late in March or early in April and continues until September.

Jefferson (Barnes); Putnam (MacDougal); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Dearborn (Collins); Clark (Baird and Taylor); Franklin (Meyncke); Kosciusko (Coulter); Monroe and Vigo (Blatchley); Fayette (Hessler); Decatur (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

A. PUBERA (Michx.) Britton. Great Chickweed.

(*Stellaria pubera* Michx.)

Open woods in rich, damp soils, common in southern and central counties, becoming less frequent farther north.

Flowers from April through June.

Tippecanoe (Cunningham); Jefferson (Barnes); Putnam (MacDougal); Monroe and Vigo (Blatchley); Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke); Fayette (Hessler); Decatur (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

A. LONGIFOLIA (Muhl.) Britton. Long-leaved Starwort or Chickweed.
(*Stellaria longifolia* Muhl.)

In rather wet soils, in low grassy places near streams and open woods, in many counties of the State.

Flowers from April through June.

Kosciusko (Coulter); Monroe and Vigo (Blatchley); Putnam (MacDougal); Jefferson (J. M. Coulter); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Clark (Baird and Taylor); Hamilton (Wilson); Steuben (Bradner).

A. LONGIPES (Goldie) Coville. Long-stalked Chickweed.
(*Stellaria longipes* Goldie.)

In moist soils of open places and borders of marshes in a few counties. Not common.

Flowers in May and June.

Vigo (Blatchley); Noble (Van Gorder); St. Joseph (Rother); Tippecanoe.

CERASTIUM L.

C. VISCOSUM L. Mouse-ear Chickweed.

Very common about fields and waste places, frequently in grassy places. Found throughout the State.

Flowering season from April through July.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Randolph (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Clark (Baird and Taylor); Fayette (Hessler); Monroe and Vigo (Blatchley); Knox (Spillman); Steuben (Bradner).

C. VULGATUM L. Larger Mouse-ear Chickweed.

Frequent in open woods, meadows and waste places in the State. In the southern counties it sometimes becomes a troublesome weed. In the northern counties it is much less frequent and from the extreme north seems entirely absent.

Flowering from April until September.

Putnam (MacDougal); Vigo and Monroe (Blatchley); Jefferson (Barnes); Jay, Delaware, Randolph and Wayne (Phinney); Clark (Baird and Taylor); Decatur (Ballard); Knox (Spillman); Hamilton and Marion (Wilson).

C. LONGIPEDUNCULATUM Muhl. Nodding Chickweed.*(C. nutans Raf.)*

One of the most common and widely distributed species of the genus. Found in fields and pastures in moist, grassy or shaded places.

Flowering from April through June.

Tippecanoe (Ives); Jefferson (Barnes); Putnam (MacDougal); Monroe and Vigo (Blatchley); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyneke); Fayette (Hessler); Knox (Spillman); Decatur (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

C. ARVENSE L. Field Chickweed.

Not at all frequent, but found in the eastern part of the State in coarse, rocky soil.

Flowering specimens collected May 17.

Franklin (Meyneke).

C. ARVENSE OBLONGIFOLIUM (Torr.) Holl. and Britt.

Somewhat common in various parts of the State, especially abundant along the upper Wabash valley in limestone soils.

Flowering from April through May.

Cass (Hessler); Daviess (Clements); Gibson and Posey (Schneck); Tippecanoe.

SAGINA L.

S. APETALA Ard. Small-flowered Pearlwort.

Found sparingly in a few counties in the southern and eastern counties growing in dry soils in shaded places.

Flowers in June.

Gibson and Posey (Schneck); Jay, Delaware, Randolph and Wayne (Phinney); Monroe (Dudley).

S. DECUMBENS (Ell.) T. and G. Decumbent Pearlwort.

Occasional in the southern part of the State in dry soil.

Flowering season, April and May.

Clark (Barnes); Jefferson.

ARENARIA L.

A. SERPYLLIFOLIA L. Thyme-leaved Sandwort.

Quite abundant in various counties, usually in dry, coarse soils, exceptionally in low, moist, sandy places.

Flowers from May until September.

Vigo (Blatchley); Clark (Baird and Taylor); Franklin (Meyncke); Jefferson (Barnes); Fayette (Hessler); Knox (Spillman).

A. STRICTA Michx.

(*A. Michauxii* Hook.)

Reported only from the northern counties in dry, coarse drift soil. Not abundant in any of its stations.

Lake (Hill); St. Joseph (Rothert).

A. PATULA Michx.

In open, dry places in Tippecanoe County, upon authority of Dr. C. R. Barnes.

Flowering specimens collected May 17.

MEHRINGIA L.

M. LATERIFLORA (L.) Fenzl. Blunt-leaved Sandwort.

(*Arenaria lateriflora* L.)

Found somewhat commonly in the central and northern counties of the State in moist soils, especially on shores of streams and lakes.

Flowers in May and June.

Jay, Delaware, Randolph, and Wayne (Phinney); Lake (Hill); Wabash (Jenkins); Fayette (Hessler).

SPERGULA L.

S. ARVENSIS L. Sandweed.

Not generally distributed nor abundant. Found only in southern part of the State so far as reports go.

Collected in flower June 18.

Clark (Baird and Taylor).

ANYCHIA Michx.

A. DICHOTOMA Michx. Forked Chickweed.

Found in thickets and other shaded places in many parts of the State. Much more widely distributed than the reports indicate.

Flowers from June until September.

Daviess (Clements); Jefferson (J. M. Coulter); Kosciusko (Chipman); Fayette (Hessler); Tippecanoe (Coulter).

A. CANADENSIS (L.) B. S. P. Slender Forked Chickweed.*(A. capillacea DC.)*

In similar situations but less common and less widely distributed.

Flowering season, June until September.

Daviess (Clements); Kosciusko (Chipman); Tippecanoe (Coulter).

NYMPHÆACEÆ. Water Lily Family.**CABOMBA Aubl.****C. CAROLINIANA A. Gray. Cabomba.**

This southern form is only found in the extreme southwestern counties, in the deeper ponds. Locally abundant.

Flowers from May until September.

Gibson and Posey (Schneck).

BRASENIA Schreb.**B. PURPUREA (Michx.) Casp. Water-shield.***(B. peltata Pursh.)*

Abundant in most lakes and sluggish streams in the State. Especially profuse in the shallow bays of the northern inland lakes.

Flowering in July and August.

Noble (Van Gorder); Laporte (Barnes); Gibson and Posey (Schneck); Kosciusko (Coulter); Marshall, Dekalb, and Monroe (Blatchley); Shriner Lake (Deam); Cass (Hessler); Steuben (Bradner).

NYMPHÆA L.**N. ADVENA Soland. Large Yellow Pond Lily.***(Nuphar advena R. Bv.)*

Common throughout the State in ponds, lakes and sluggish streams, frequently almost completely choking ditches.

Flowers from April until September.

Kosciusko (Coulter); Cass (Hessler); Laporte (Barnes); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Vermillion (Wright); Monroe and Vigo (Blatchley); Clay and Putnam (MacDougal); Round Lake (Deam); Hamilton (Wilson); Steuben (Bradner).

N. SAGITTÆFOLIA Walt. Arrow-leaved Pond Lily.

A species that has found its way from the south into our south-western counties. Rare, in the deeper ponds of the region.

Flowers collected June 23.

Gibson and Posey (Schneck).

CASTALIA Salisb.

C. ODORATA (Dryand) Woodv. and Wood. Pond Lily. White Water Lily. Sweet-scented Water Lily.

(*Nymphaea odorata* Ait.)

Abundant in many parts of the State, especially in the region of the small lakes and in the swamp regions of the Kankakee. Found, however, throughout the entire State.

Flowers late in June and continues through August.

Kosciusko (Coulter); Loporte (Barnes); Gibson and Posey (Schneck); Vigo (Blatchley); Round Lake (Deam); Kankakee (Hussey); Steuben (Bradner).

C. TUBEROSA (Paine) Greene. Tuberous White Water Lily.

(*Nymphaea reniformis* DC.)

In ponds and sluggish streams in various parts of the State. Usually common in the stations in which it occurs.

Flowers from June through August.

Cass (Hessler); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); St. Joseph (Rothert); Vigo (Blatchley).

NELUMBO Adans.

N. LUTEA (Willd.) Pers. American Lotus. Water Chinquapin.

Found only in the southern part of the State where it is locally rather common in deep ponds. The farinaceous tuber and seeds are edible.

Flowering in July and August.

Gibson and Posey (Schneck); Vigo (Blatchley).*

CERATOPHYLLACEÆ. Hornwort Family.

CERATOPHYLLUM L.

C. DEMERSUM L. Hornwort.

In ponds and sluggish streams in various parts of the State. Usually overlooked by collectors because of its submerged habit.

*Occurs also near Attica, Fountain County.—W. S. B.

Probably to be found in all parts of the State if looked for in June and July.

Flowers from June until in August.

Hamilton (Wilson); Kosciusko (Coulter); Lake (Hill); Gibson.

MAGNOLIACEÆ. Magnolia Family.

MAGNOLIA L.

M. ACUMINATA L. Cucumber Tree.

Found native in sparing numbers in the counties fronting the Ohio River. It is usually found in moist, alluvial soils. It is largely cultivated as an ornamental form in lawns and parks, and has proved itself able to withstand the rigors of winter as far north as Tippecanoe County.

Flowers in May and June.

Jefferson and Tippecanoe (Coulter); Putnam (MacDougal).

LIRIODENDRON L.

L. TULIPIFERA L. Yellow Poplar. White Wood. Tulip Tree.

Indicative of rich soils and formerly largely distributed throughout the State. In the early history of the State it was one of the most numerous and largest of the forest trees. It reaches its greatest development in the valley of the lower Wabash River, but is being rapidly exterminated. Dr. Schneck gives the following measurements of a specimen in Gibson County: "Circumference above roots and swells, 25 feet; height of trunk from roots to first branch, 91 feet; total height, 190 feet." A measurement of 150 specimens in Jefferson County gave an average diameter of three and one-half feet at three feet above the ground, and an average height of 87 feet. The tree from an economic standpoint is one of the most valuable occurring in our area, and this high value has led to its practical extermination. I have observed it growing freely in second growth timber in the southern counties, a fact which suggests that it would well repay culture. Cattle can not be pastured in a poplar grove without damage to the trees. Where areas have been heavily pastured for a few years, all the poplars, even the largest forms, have been killed.

The flowering season is in May and June.

Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Kosciusko and Jefferson (Coulter); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner); Fayette (Hessler).

ANONACEÆ. Custard-apple Family.

ASIMINA Adans.

A. TRILOBA (L.) Dunal. Papaw. Custard Apple.

Extremely abundant in the southern part of the State where it covers wide areas. Less common farther north, but found in most counties of the State. It is usually found in rich, rather low woods, though very abundant on limestone hills in the southern part of the State. It reaches its greatest development in the lower Wabash valley, where at times it is from 12 to 15 inches in diameter. The wood is of no especial value; the bark, after maceration, is sometimes used for ropes and mats. The leaves are supposed to exert a preservative influence, and are largely used by small dealers for covering meat, fresh dressed poultry and fish.

Two forms, not separated botanically, are associated in our area. They differ in time of flowering, in size, shape, color and flavor of the fruit, in leaf shape, venation and odor and in color of the bark. They are of constant popular recognition and are probably separate species, never seeming to intergrade.

Flowering season March and April.

Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Kosciusko (Coulter); Decatur (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner); Cass and Fayette (Hessler).

RANUNCULACEÆ. Crowfoot Family.

HYDRASTIS Ellis.

H. CANADENSIS L. Yellow Puccoon. Yellow Root.

Found throughout the State in rich soils on hillsides or in woods. It is disappearing in many parts of the State, partly because of cultural changes, partly because of its being largely used as a household remedy.

Flowering season, April and May.

Tippecanoe (Cunningham); Daviess (Clements); Clark (Baird and Taylor); Franklin (Meyncke); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Noble (Van Gorder); Dearborn (Collins); Jay, Delaware, Randolph and Wayne (Phinney); Monroe and Vigo (Blatchley); Fayette (Hessler); Putnam (MacDougal); Decatur and Shelby (Ballard); Hamilton (Wilson); Steuben (Bradner).

CALTHA L.

C. PALUSTRIS L. Marsh Marigold. Marsh Cowslip.

Frequent in wet places in many parts of the State. Usually found in marshes and swamps. In some of the central counties it is rare, but in most stations is quite common.

Flowers in April and May.

Tippecanoe (Cunningham); Kosciusko (Coulter); Cass (Hessler); Monroe and Vigo (Blatchley); Putnam (MacDougal); Franklin (Meyncke); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Fayette (Hessler); Knox (Spillman); St. Joseph (Bohert); Decatur and Shelby (Ballard); Hamilton (Wilson); Steuben (Bradner).

COPTIS Salisb.

C. TRIFOLIA (L.) Salisb. Gold-thread.

This northern species was first recorded as a member of the State flora by Mr. W. B. Van Gorder. With us it is found only in the northern counties growing in sphagnum morasses or tamarack swamps. Its yellow root is bitter to the taste, and because of its supposed healing properties has given to the plant the name "Canker Root." Not abundant in any of its stations.

Flowering from May through July.

Fulton (Hessler); Noble and Dekalb (Van Gorder); Steuben (Bradner).

ISOPYRUM L.

I. BITERNATUM (Raf.) T. and G. False Rue Anemone.

A common spring form in most parts of the State growing in moist open woods and shady places. It prefers rich soil, rarely being found in sandy soil. In the southern counties it is exceptionally plentiful in beech woods.

Flowering season, May and June.

Jefferson (Barnes); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Cass (Hessler); Daviess (Clements); Kosciusko (Coulter); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Knox (Spillman); Shelby (Ballard); Hamilton and Marion (Wilson).

ACTÆA L.

A. RUBRA (Ait.) Willd. Red Baneberry.*(A. spicata rubra Ait.)*

In moist woods and thickets in several counties of the State. Very difficult to separate from *A. alba* unless the forms are in fruit. Associated with *A. alba*, but much less common.

Flowering season, April and May.

Tippecanoe (Hussey); Jefferson (J. M. Coulter); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder).

A. ALBA (L.) Mill. White Baneberry.

Of wide distribution in the State and common in shaded localities, in moist, rich soil. Found in dense woods and thickets, very rarely in open places. Quite variable, intergrading with the preceding species.

Flowering season, April and May.

Jefferson (Barnes); Tippecanoe (Miles and Earl); Monroe and Vigo (Blatchley); Fayette (Hessler); Putnam (MacDougal); Gibson and Posey (Schneck); Kosciusko (Coulter); Jay, Delaware, Randolph and Wayne (Phinney); Daviess (Clements); Clark (Baird and Taylor); Franklin (Meyncke); Noble (Van Gorder); Round Lake (Dean); Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

CIMCIFUGA L.

C. RACEMOSA (L.) Nutt. Black Snakeroot. Black Cohosh.

In shady places, in rich sandy soil. Formerly very abundant, but now rapidly disappearing. Not reported farther north than Tippecanoe County.

Flowers in June and July.

Fayette (Hessler); Gibson and Posey (Schneck); Clark (Baird and Taylor); Kosciusko (Coulter); Franklin (Meyncke); Jefferson (J. M. Coulter); Dearborn (Collins); Tippecanoe (Conner and Laben); Shelby (Ballard).

AQUILEGIA L.

A. CANADENSIS L. Wild Columbine.

Abundant in the southern part of the State, chiefly on limestone rocks and ledges. The species becomes less frequent in the

northern counties where it is usually found in coarse soils or about old stumps.

Flowers from April until late in August.

Monroe and Vigo (Blatchley); Fayette (Hessler); Putnam (MacDougal); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Kosciusko (Coulter); Clark (Baird and Taylor); Franklin (Meyncke); Jefferson (J. M. Coulter); Noble (Van Gorder); Dearborn (Collins); Jay, Delaware, Randolph and Wayne (Phinney); St. Joseph (Rother); Decatur and Shelby (Ballard); Steuben (Bradner).

A. VULGARIS L. European Columbine.

Escaped from cultivation in different parts of the State and maintaining itself well in rocky or coarse gravel soils. It escapes more frequently in the southern counties and is not infrequent in the neighborhood of abandoned dwellings.

Flowers in May and June.

Noble (Van Gorder); Gibson and Posey (Schneck); Clark (Baird and Taylor); Jefferson (J. M. Coulter).

DELPHINIUM L.

D. CONSOLIDA L. Field Larkspur.

Quite common in the southern counties, much less so in the northern part of the State. It usually occurs in old fields and along roadsides, apparently having entered our flora as an escape from cultivation.

Flowers from May until September.

Jefferson and Madison (J. M. Coulter); Fayette (Hessler); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Vigo (Blatchley); Steuben (Bradner).

D. URCEOLATUM Jacq. Tall Larkspur.

(*D. exaltatum* Ait.)

This species is doubtfully admitted upon rather scant specimens from Wayne County. In view of the antecedent report of the occurrence of the species in the same locality by Dr. Phinney I have allowed the reference to stand.

Collected in flower May 29th.

Wayne (Phinney); Dearborn (Collins).

D. CAROLINIANUM Walt. Carolina Larkspur.*(D. azureum* Michx.)

Reported from two counties and admitted upon the "legit" of Dr. John M. Coulter. The range probabilities are decidedly against the occurrence of the form in Indiana. I have seen no specimens, but rest the admission of the species upon the authority cited.

Flowering specimens collected June 7th.

Wayne (Phinney); Jefferson (J. M. Coulter).

D. TRICORNE Michx. Common or Dwarf Larkspur.

Found in all parts of the State in fair abundance in rich soils. Usually more plentiful and of better development in woods or upon shaded hillsides. The species is very variable both as to size, color of the flowers, denseness of raceme and amount of spreading of follicles. This variability makes it possible that the two preceding species may be found to be extreme forms of *D. tricornis*.

Flowers from April through June.

Jefferson and Madison (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Tippecanoe (Coulter); Daviess (Clements); Clark (Baird and Taylor); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Knox (Spillman); Shelby (Ballard); Kosciusko (Coulter); Hamilton (Wilson).

ANEMONE L.

A. CAROLINIANA Walt. Carolina Anemone.

Added to the flora by Mr. W. S. Blatchley, who reports it as rare on the "borders of prairies and in dry, open woods."

Collected in flower in April.

Vigo (Blatchley).

A. CYLINDRICA A. Gray. Long-fruited Anemone.

In the northern part of the State growing in open places in rather rich, sandy soil. Quite frequent.

Flowering season, June until August.

Tippecanoe (Hussey); Elkhart (Barnes); Putnam (MacDougal); Kosciusko (Coulter); Noble (Van Gorder); Steuben (Bradner).

A. VIRGINIANA L. Tall Anemone.

Of wide distribution in the State, found usually in low, rich soil. It occurs either in the woods or in open places with its best development in the former. Frequent in most of its stations.

Flowering from June until September.

Jefferson (Barnes); St. Joseph (Rothert); Vigo and Monroe (Blatchley); Gibson and Posey (Schneck); Putnam (MacDougal); Kosciusko (Coulter); Daviess (Clements); Clark; Baird and Taylor; Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Steuben (Bradner).

A. CANADENSIS L. Canada Anemone.

(*A. Pennsylvanica* L.)

The most widely distributed and abundant member of the genus in the State. It occurs in various situations, but most frequently in low, shaded places in rich soils. It is, however, found in dry, gravelly or sandy soils, but never in great abundance in such a situation.

Flowers from May until the middle of September.

Tippecanoe (Hussey); Elkhart (Barnes); St. Joseph (Rothert); Fayette (Hessler); Vigo (Blatchley); Gibson and Posey (Schneck); Daviess (Clements); Cass (Hessler); Noble (Van Gorder); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Hamilton and Marion (Wilson); Decatur (Ballard).

A. QUINQUEFOLIA L. Wind flower. Wild Anemone.

(*A. nemorosa* Michx.)

Not at all common in the State. The forms usually so referred are either *Isopyrum biternatum* or *Syndesmon thalictroides*. The species is apparently confined to the southern part of the State, where it grows in low, open woods in rich soils.

Flowers from April through June.

Jefferson (Barnes); Gibson and Posey (Schneck); Decatur and Shelby (Ballard); Steuben (Bradner).

HEPATICA Scop.**H. HEPATICA (L.) Karst. Hepatica. Round-leaved Liverwort.**

(*H. triloba* Chaix.)

One of the earliest blooming forms. It is found in several counties of the State growing in protected places about the roots of trees and in sheltered ravines. It is much less abundant than

the following species with which it is associated and with which it intergrades.

Flowering from first warm days in February or March until in June or July.

Tippecanoe (Cunningham); Kosciusko (Coulter); St. Joseph (Rothert); Decatur (Ballard); Lake (Hill).

H. ACUTA (Pursh) Britton. Liverwort. Spring Hepatica.
(*H. acutiloba* DC.)

In similar situations as the preceding, but more widely distributed and much more plentiful. The prevailing form in the State.

Flowers from March through June.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Putnam (MacDougal); Gibson and Posey (Schneck); Decatur (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

SYNDESMON Hoffmg.

S. THALICTROIDES (L.) Hoffmg. Rue Anemone.

(*Anemonella thalictroides* Spach.)

Widely distributed and abundant in most parts of the State. A very variable form growing most plentifully in rich, open woods, less common in sandy soils and rare in drift soils. Often mistaken for the wind flower, *Anemone quinquefolia*.

Flowering season from March through June.

Jefferson and Madison (Barnes); Monroe and Vigo (Blatchley); Fayette and Cass (Hessler); Lake (Hill); Putnam (MacDougal); Gibson and Posey (Schneck); Clark (Baird and Taylor); Tippecanoe (Cunningham); Daviess (Clements); Kosciusko (Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Noble (Van Gorder); Franklin (Meyncke); St. Joseph (Rothert); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

CLEMATIS L.

C. VIRGINIANA L. Virgin's Bower. Wild Clematis.

Found in all parts of the State, usually in abundance. It grows most luxuriantly in rich, loose soils in shaded places. It is frequently very abundant near the borders of thickets along streams. A handsome vine well worthy of more general cultivation.

Flowers from June until September.

Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Fayette (Hessler); Putnam (MacDougal); Gibson and Posey (Schneck); Kosciusko (Coulter); Clark (Baird and Taylor); Franklin (Meyncke); Dearborn (Collins); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Tippecanoe, Hamilton and Marion (Wilson); Steuben (Bradner).

C. SIMSII Sweet. Sim's Clematis

(*C. Pitcheri* Torr. and Gray.)

Confined to the southern counties where it is sparingly found in rich bottom lands, or along railroads. Evidently having entered our flora from the south, the Indiana stations marking the northern limit of the species.

Flowers in May and June.

Daviess (Clements); Gibson and Posey (Schneck); Vigo (Blatchley).

C. VIORNA L. Leather Flower.

A vine climbing over bushes and underbrush, usually growing in rich moist soils. Abundant in the southern counties, becoming less frequent northward, with no stations reported north of Tippecanoe County.* Easily recognized by the remarkably thick sepals of the purple calyx.

Flowers from May until late in June.

Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Fayette (Hessler); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke); Dearborn (Collins); Tippecanoe (Cunningham); Hamilton (Wilson).

MYOSURUS L.

M. MINIMUS L. Mouse Tail.

Reported as occurring occasionally in rich, bottom lands in the southwestern counties of the State.

Flowers in our area in May and June.

Gibson and Posey (Schneck).

*C. VIORNA has been taken by me near Delphi, Carroll County, and by Hessler in Cass County.—W. S. B.

TRAUTVETTERIA F. and M.

T. CAROLINENSIS (Walt.) Vail. False Bugbane.

(T. palmata F. and M.)

In the hill regions in the southern counties of the State. Not abundant in any of its stations, but included in most collections from that region.

Flowering in June and July.

Floyd (Clapp); Clark (Barnes).

RANUNCULUS L.

R. DELPHINIFOLIUS Torr. Yellow Water Crowfoot.

(R. multifidus Pursh.)

Rather abundant in ponds and shallow, sluggish streams in various counties of the State.

Flowers from early in May until August.

Tippecanoe (Hussey); Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Dearborn (Collins); Noble (Van Gorder); Knox (Spillman); Hamilton (Wilson); Steuben (Bradner).

R. PURSHII Richards. Pursh's Buttercup.

(R. multifidus terrestris Gray.)

In wet soils near margins of lakes and ponds, or on the banks of sluggish streams. Plentiful in the stations in which it occurs.

Flowers from May until in July.

Tippecanoe (Cunningham); Vigo (Blatchley); Daviess (Clements); Marshall (Hessler).

R. PUSILLUS Poir. Low Spearwort.

Reported from a single station and verified by herbarium specimens. I have not seen the specimens, but regard the occurrence of the form within our area as practically impossible. The form is entered under the rules governing the preparation of the catalogue pending examination of the specimens.

Knox (Spillman).

R. REPTANS L.

(R. Flammula reptans Meyer.)

Confined to the counties fronting the Ohio River, and found growing along its shores.

Flowers from June until August.

Jefferson (J. M. Coulter); Clark (Baird and Taylor).

R. OBRUSIUSCULUS Raf. Water Plantain Spearmint.*(R. ambigena Wats.)*

In marshes and at borders of ponds in various parts of the State. Not abundant in any of its stations.

Flowers from June until in August.

Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Noble (Van Gorder); Decatur and Shelby (Ballard).

R. ABORTIVUS L. Kidney-leaved Crowfoot.

Found abundantly throughout the State in moist grounds in shaded places. It frequently invades well watered lawns becoming an annoying weed. Its best development is found in rich soils although it is not uncommon in dry, sterile situations. The form is extremely variable.

Flower from the middle of March until September or later.

Jefferson (Barnes); Tippecanoe (Hussey); Vigo and Monroe (Blatchley); Fayette (Hessler); Putnam (MacDougal); Gibson and Posey (Schneck); Kosciusko (Coulter); Daviess (Clements); Clark (Baird and Taylor); Dearborn (Collins); Franklin (Meyncke); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Knox (Spillman); Decatur and Shelby (Ballard); St. Joseph (Rothert); Hamilton and Marion (Wilson).

R. MICRANTHUS Nutt. Rock Crowfoot.*(S. abortivus micranthus Gray.)*

In pastures and on hillsides in coarse or sandy soil, or upon rocks. Confined chiefly to southern counties.

Flowers from April through August.

Jay, Delaware, Randolph, and Wayne (Phinney); Vigo (Blatchley); Franklin (Meyncke); Gibson and Posey (Schneck); Knox (Spillman); Jefferson (J. M. Coulter).

R. SCELERATUS L. Ditch Crowfoot. Cursed Crowfoot.

In swamps and brooks, also along the shores of ditches. Found in a few counties, and not abundant in any of its stations.

Flowers from April through July.

Noble (Van Gorder); Cass (Hessler); Vigo (Blatchley); Tippecanoe; Steuben (Bradner).

R. RECURVATUS Poir. Hooked Crowfoot.

In many counties of the State growing in open woods and fields. The species prefers loose, rich, moist soil and rather shaded localities.

Flowering season from April through June.

Tippecanoe (Hussey); Monroe and Vigo (Blatchley); Fayette (Hessler); Putnam (MacDougal); Gibson and Posey (Schneck); Kosciusko (Coulter); Daviess (Clements); Clark (Baird and Taylor); Franklin (Meyncke); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Knox (Spillman); St. Joseph (Rothert); Hamilton and Marion (Wilson); Steuben (Bradner).

R. ACRIS L. Tall or Meadow Buttercup.

Found in isolated stations in a few counties. It usually grows in meadows or fields in dry soils.

Flowers from May until August.

Monroe (Blatchley); Putnam (MacDougal); Dearborn (Collins); Marion (Hessler).

R. BULBOSUS L. Bulbous Buttercup.

Sparingly found in a few counties in fields and along roadsides in dry, generally sandy soil.

Flowers from May until August.

Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins).

R. PENNSYLVANICUS L. f. Bristly Buttercup.

Chiefly northern in its distribution in very damp, open places, usually not far removed from streams or lakes.

Flowering season, June and July.

LaPorte (Barnes); Putnam (MacDougal); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Steuben (Bradner).

R. MACOUNII Britton. Macoun's Buttercup.

(*R. hispidus* Hook.)

Added to the flora by Mr. W. S. Blatchley, the verifying specimens being in the DePauw herbarium. The species is a member of our flora, but has as yet no other station than that discovered by Mr. Blatchley.

Monroe (Blatchley).

R. REPENS L. Creeping Buttercup.

Common in fields and meadows, usually in low, damp places. In the stations in which it occurs it is ordinarily plentiful, though not of as wide distribution as the following species, with which it is often confused.

Flowers from April until July.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Monroe (Blatchley); Fayette (Hessler); Kosciusko (Coulter); Daviess (Clements); St. Joseph (Rothert); Steuben (Bradner).

R. SEPTENTRIONALIS Poir. Swamp or Marsh Buttercup.

Common in marshes and very wet low places. Usually indicative of rich soils though occasionally ranging into dry, sterile places. In the latter situation it is frequently mistaken for *R. acris*.

Flowers from April until August.

Jefferson (J. M. Coulter); Putnam (MacDougal); Monroe and Vigo (Blatchley); Gibson and Posey (Schneck); Kosciusko (Coulter); Daviess (Clements); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyneke); Dearborn (Collins); Knox (Spillman); Hamilton and Marion (Wilson).

R. FASCICULARIS Muhl. Early Buttercup.

Of wide distribution and abundant in its various stations. Found chiefly in dry, sandy soils in fields or on rocky hillsides.

Flowers in April and May.

Monroe and Vigo (Blatchley); Jefferson (Barnes); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Kosciusko (Coulter); Dearborn (Collins); Noble (Van Gorder); Franklin (Meyneke); Clark (Baird and Taylor); Decatur and Shelby (Ballard); St. Joseph (Rothert); Steuben (Bradner).

BATRACHIUM. S. F. Gray.**B. TRICHOPHYLLUM (Chaix.) Bossch Stiff White Water Crowfoot.**

(*Ranunculus aquatilis trichophyllus* DC)

Found in lakes, ponds and sluggish streams in various parts of the State. More abundant in the northern than in the southern counties. Abandoned parts of the Wabash and Erie Canal are in many places absolutely occupied by this plant.

Flowers in April and May.

LaPorte (Barnes); Vigo (Blatchley); Johnson (Hubbard); Gibson and Posey (Schneck); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Kosciusko (Coulter); Tippecanoe (Cunningham); St. Joseph (Rothert); Steuben (Bradner).

B. DIVARICATUM (Schrank.) Wimmer. Stiff Water Crowfoot.
(*Ranunculus circinatus* Sibth.)

Reported as common in Hamilton County, by Mr. G. W. Wilson.

Flowers from June through August.

THALICTRUM L.

T. DIOICUM L. Early Meadow Rue.

Common in almost every part of the State. It usually indicates a loose, rich soil. It is found in open woods, in waste places, and on rocky hillsides in about equal abundance.

Flowers in April and May.

Tippecanoe (Cunningham); Jefferson (Barnes); Monroe and Vigo (Blatchley); Cass and Fayette (Hessler); Gibson and Posey (Schneck); Kosciusko (Coulter); Daviess (Clements); Clark (Baird and Taylor); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Hamilton (Wilson); Steuben (Bradner).

T. PURPURASCENS L. Purplish Meadow Rue.

Rich soils in thickets and open woods; abundant in almost all parts of the State.

Flowers from early in May until August.

Jefferson (J. M. Coulter); Floyd (Clapp); Vigo and Monroe (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Kosciusko (Coulter); Daviess (Clements); Clark (Baird and Taylor); Franklin (Meyncke); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney).

T. POLYGAMUM Muhl Tall Meadow Rue.

(*T. Cornuti* T. and G.)

Borders of ditches and swamps, and in very wet, sunny lowlands. Nowhere especially abundant, but found in all parts of the State.

Flowers from May through August.

Monroe and Vigo (Blatchley); Fayette and Cass (Hessler); Putnam (MacDougal); Tippecanoe (Cunningham); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Noble (Van Gorder); Jefferson (J. M. Coulter); Hamilton and Marion (Wilson); Steuben (Bradner).

BERBERIDACEÆ. Barberry Family.**BERBERIS L.****B. VULGARIS L. Common Barberry.**

In thickets in dry soils in several counties of the State. Apparently thoroughly naturalized in the southern counties; not reported from north of Tippecanoe County save as cultivated. Characterized by its three pronged spines and its yellow flowers, which have a heavy, sickening odor.

Flowers from May until July.

Jefferson (Barnes); Clark (Baird and Taylor); Franklin (Meyncke); Wayne (Phinney); Tippecanoe (Laben and Conner).

CAULOPHYLLUM Michx.**C. THALICTROIDES L. Blue Cohosh.**

Found in most parts of the State occurring in dense woods and thickets, in rich soils. It is of very rare occurrence in drift soils. More abundant in the central and southern counties than farther north.

Flowering in April and May.

Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Cass (Hessler); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Dearborn (Collins); Decatur (Ballard); Hamilton (Wilson); Steuben (Bradner).

JEFFERSONIA Bart.**J. DIPHYLLA (L.) Pers. Twin Leaf. Rheumatism Root.**

Abundant in rich soils in the southern part of the State, becoming less frequent northward, and not reported from north of Tippecanoe County. Usually found in shaded places.

Flowers in April and May.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam and Union (MacDougal); Fayette (Hessler); Tippecanoe (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Clark (Baird and Taylor); Dearborn (Collins); Decatur (Ballard).

PODOPHYLLUM L.

P. PELTATUM L. May Apple. Mandrake.

A familiar form found throughout the State in rich soil, in moist shaded places. The yellowish fruit is edible, but has a rather sickening odor.

Flowers in May.

Clark (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Daviess (Clements); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Dearborn (Collins); Jefferson (J. M. Coulter); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

MENISPERMACEÆ. Moonseed Family.

CEBATHA Forsk.

C. CAROLINA (L.) Britton. Carolina Moonseed.

(*Cocculus Carolinus* DC.)

A species having entered our flora from the south, and found only in the extreme southwestern counties. It is there common in river bottoms in rich, sandy soil. A slender training or climbing vine.

Flowering season from June until August.

Gibson and Posey (Schneck).

MENISPERMUM L.

M. CANADENSE L. Moonseed Vine.

In woods and along streams, usually in rich alluvial soils in the central and southern counties of the State. An attractive plant climbing over bushes and underbrush, with large cordate leaves, and bearing later in the season clusters of blue-black fruit, not unlike small grapes in appearance. Ordinarily abundant in stations in which it grows.

Flowers in June and July, or in the extreme southern counties in May and June.

Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Hamilton and Marion (Wilson); Steuben (Bradner).

LAURACEÆ. Laurel Family.

SASSAFRAS Nees and Eberm.

S. SASSAFRAS (L.) Karst. Common Sassafras.

(S. officinale Nees.)

Widely distributed throughout the State. In the northern counties usually reduced to a shrub, in the southern and southwestern reaching its highest development, occasionally reaching a diameter of five or six feet with a height of seventy-five feet. It averages, however, from forty to fifty feet in height with a diameter of from eighteen to thirty inches. In the localities where it occurs it frequently occupies almost exclusively wide areas. The wood is light and weak, but extremely durable in contact with the soil. It is used for skiffs, yokes, etc., and very largely for posts, rails and cooperage. Every part is aromatic, the root being largely used for its oil.

Flowers in April and May; fruit ripens in August.

Tippecanoe (Cunningham); Putnam (MacDougal); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Franklin (Meynecke); Dearborn (Collins); Vigo (Blatchley); Kosciusko (Coulter); Hamilton and Marion (Wilson); Steuben (Bradner); Cass (Hessler).

BENZOIN Fabric.

B. BENZOIN (L.) Coulter. Spice Bush. Wild Allspice.

(Lindera Benzoin Blume.)

An aromatic shrub found in many counties of the State in moist, rich soils in shaded places.

Flowers in March and April; fruit ripens in August and September.

Tippecanoe (Cunningham); Jefferson (Barnes); Putnam (MacDougal); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Noble (Van Gorder); Franklin (Meynecke); Dearborn (Collins); Hamilton and Marion (Wilson); Steuben (Bradner); Cass and Fayette (Hessler).

PAPAVERACEÆ. Poppy Family.**PAPAVER L.****P. SOMNIFERUM L. Opium or Garden Poppy.**

Escaped from cultivation in some of the southern counties where it maintains itself in waste places in rather coarse soils.

Flowers from June until September.

Clark (Baird and Taylor); Franklin (Meyncke); Jefferson (J. M. Coulter).

ARGEMONE L.**A. MEXICANA L. Prickly Poppy.**

Found occasionally in the southwestern counties in waste places. Added to the flora by Dr. J. Schneck.

Flowers from June through August.

Gibson and Posey (Schneck).

SANGUINARIA L.**S. CANADENSIS L. Bloodroot.**

Common in all parts of the State, usually growing in rich soils. It is especially abundant in open woods and the protected slopes of ravines.

Flowering begins in March and continues until May.

Jefferson (Barnes); Tippecanoe (Coulter); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Daviess (Clements); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Vermillion (Wright); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); Decatur and Shelby (Ballard); St. Joseph (Rothert); Kosciusko (Coulter); Hamilton and Marion (Wilson); Steuben (Bradner).

STYLOPHORUM. Nutt.**S. DIPHYLLUM (Michx.) Nutt. Yellow or Celandine Poppy.**

Abundant in most parts of the State, in moist, rich soils. Particularly frequent in low woods and the protected slopes of ravines.

Flowering season, April and May.

Jefferson (Barnes); Clark (Barnes); Tippecanoe (Hussey); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Kosciusko (Coulter); Franklin (Meyncke); Noble (Van Gorder); Dearborn (Collins); Wayne (Phinney); Decatur (Ballard); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

CHELIDONIUM L.

C. MAJUS L. Celandine.

Admitted to the flora upon the authority of Dr. L. M. Underwood, who reports it as occurring along the Vandalia Railroad near Greencastle.

Collected in flower early in June.

Putnam (Underwood); Steuben (Bradner).

BICUCULLA Adans.

B. CUCELLARIA (L.) Millsp. Dutchman's Breeches.

(*Dicentra Cucullaria* Torr.)

Common throughout the State in moist, rich soils in shaded places. Usually very abundant in its stations.

Flowers from March until in May.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Vigo and Monroe (Blatchley); Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Franklin (Meyncke); Gibson and Posey (Schneck); Decatur and Shelby (Ballard); Knox (Spillman); Cass and Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

B. CANADENSIS (Goldie) Millsp. Squirrel Corn.

(*Dicentra Canadensis* DC.)

Of wide distribution and usually abundant in situations similar to the preceding. Flowers very fragrant.

Flowers from April until in June.

Kosciusko (Coulter); Putnam (MacDougal); Vigo and Monroe (Blatchley); Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Franklin (Meyncke); Jefferson (J. M. Coulter); Decatur (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

ADLUMIA Raf.

A. FUNGOSA (Ait.) Greene. Climbing Fumitory.

(*A. cirrhosa* Raf.)

Found sparingly in the northern part of the State in moist woods and thickets. A slender vine climbing over other plants by its slender petioles.

Flowers from June until the early frosts.

Steuben (Bradner).

CAPNOIDES Adans.

C. SEMPERVIRENS (L.) Borck. Pink Corydalis.
(*Corydalis glauca* Pursh.)

A northern form which is found only in our extreme northern counties. It is there found on sand ridges relatively near the beach, being one of the alpine members of the flora of the dune region.

Flowers from May until September.
Lake (Hill); Porter (Cowles).

C. FLAVULUM (Raf.) Kuntze. Pale Corydalis.
(*Corydalis flavula* Raf.)

Quite frequent, especially in the southern part of the State. It grows in rich woods, thriving best in soils with considerable admixtures of sand.

Flowering season, from April until June.
Cass (Hessler); Jefferson (Barnes); Putnam (MacDougal); Clark (Baird and Taylor); Dearborn (Collins); Franklin (Meyncke); Gibson and Posey (Schneck); Vigo (Blatchley).

C. AUREUM (Willd.) Kuntze. Golden Corydalis.
(*Corydalis aurea* Willd.)

Reported only from the "Knob" regions in southern Indiana. Neither common nor of wide distribution.

Flowering in April and May.
Floyd (Clapp).

FUMARIA L.

F. OFFICINALIS L. Hedge Fumitory.

Occasionally found in the eastern counties of the State in dry, coarse soil in waste places. Probably migrant.

Flowering specimens collected July 3d.
Wayne (Phinney); Franklin (Meyncke).

CRUCIFERÆ. Mustard Family.

LEPIDIUM L.

L. VIRGINICUM L. Wild Pepper-grass. Canary-grass.

Probably found in every county in the State. It occurs abundantly along streets and roadsides and at times becomes a very annoying weed in lawns and dooryards. Its size and general habit

vary greatly, the leaves especially showing modifications. It begins flowering early in May, or in favorable seasons in April, and continues through September. Its fruit furnishes food for many of the smaller birds. Its distribution is so general that a citation of counties in which it is reported to occur is unnecessary.

L. APETALUM Willd.

(*L. intermedium* Gray.)

Very closely allied to the preceding from which it is probably not generally distinguished. While the general range of the species includes Indiana, the mass distribution is decidedly eastern. It is doubtful if it occurs in any abundance in the State.

Flowers, May to September.

Clark (Baird and Taylor); Decatur (Ballard); Vigo (Blatchley).

SISYMBRIUM L.

S. OFFICINALE (L.) Scop. Hedge Mustard.

Common throughout the State in waste places. The flowering season begins in April, and in some of the southern counties continues until in December. It affects dry soils, and is especially abundant about dwellings or in abandoned fields.

Jefferson (Barnes); Tippecanoe (Coulter); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Daviess (Clement); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Hamilton and Marion (Wilson).

CAKILE Gaertn.

C. EDENTULA (Bigel.) Hook. American Sea-rocket.

(*C. Americana* Nutt.)

The character plant of the middle beach, extending also to the upper beach, of Lake Michigan in Lake and Porter counties. The plant is a sand plant, confined to the seashore and the shores of the Great Lakes. When extending farther inland *Cakile* is usually found on windward slopes of active dunes. The succulent character of the form adapts it admirably for the extreme xerophilous conditions to which beach plants are subjected. It has a habit somewhat resembling the "tumble weeds," the distribution of the seeds being thus secured.

SINAPIS L.

S. ALBA L. White Mustard.*(Brassica alba Boiss.)*

Only occasionally found in waste fields and evidently escaped from cultivation. Reported from several southern counties. Herbarium specimens from Jefferson (J. M. Coulter).

Hamilton (Wilson); Steuben (Bradner).

BRASSICA L.

B. NIGRA (L.) Koch. Black Mustard.

Common in waste and cultivated grounds throughout the State. In some communities classed among the bad weeds.

Flowering season from May to September.

Monroe and Vigo (Blatchley); Fayette (Hessler); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Daviess (Clements); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Putnam (MacDougal); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

B. ARVENSIS (L.) B. S. P. Charlock. Wild Mustard.*(B. Sinapistrum Boiss.)*

In waste fields and along roadsides and streets. Rather common in the southern counties but not reported as occurring north of Putnam.

Flowering season, May and June.

Monroe and Vigo (Blatchley); Putnam (MacDougal); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Dearborn (Collins); Hamilton and Marion (Wilson); Steuben (Bradner).

BARBAREA R. Br.

B. BARBAREA (L.) MacM. Yellow Rocket or Cress.*(B. vulgaris R. Br.)*

Usually found in dry soil, preferably in waste fields, but occasionally in low ground along streams. It is nowhere especially abundant, and has no reported station north of Tippecanoe.

Flowering season, April to June.

Tippecanoe (Cunningham); Putnam (MacDougal); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Monroe (Blatchley); Hamilton (Wilson); Fayette (Hessler).

B. STRICTA Andrz.

Reported only from Putnam County, by D. T. MacDougal. The specimen seems to be *B. stricta*, but range probabilities are so strongly against it that it is somewhat doubtfully included.

IODANTHUS Torr. and Gr.

I. PINNATIFIDUS (Michx.) Steud. Purple or False Rocket.

(*Thelypodium pinnatifidum* S. Wats.)

Frequent in the southern part of the State on rich hillsides or in low, rich woods.

It flowers in May and June, although most abundantly in May.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Franklin (Meynecke); Daviess (Clements); Clark (Baird and Taylor); Dearborn (Collins); Decatur (Ballard); Hamilton (Wilson).

RORIPA Scop.

R. SINUATA (Nutt.) A. S. Hitchcock. Spreading Yellow Cress.

(*Nasturtium sinuatum* Nutt.)

A specimen in the Herbarium of DePauw University, collected by Dr. MacDougal, is referred to this species. The range of the form is much to the west of Indiana, and it is doubtful whether it is more than an accidental migrant. It is reported from no other station than that in Putnam County.

R. OBTUSA (Nutt.) Britton. Blunt-leaved Yellow Cress.

(*Nasturtium obtusum* Nutt.)

Reported from Tippecanoe County by Professor Hussey, and from Clark by Baird and Taylor. The Tippecanoe County reference is verified by herbarium specimens. Low grounds in rich soil.

R. PALUSTRIS (L.) Bees. Marsh Cress. Yellow Water Cress.

(*Nasturtium palustre* DC.)

Largely distributed throughout the State, growing in low ground, swamps or shallow water. Its flowering season extends from May to September. The form varies so greatly in its different stations that it suggests that some sparsely distributed species of this genus should be referred to this.

Jefferson, Clark, and Noble (Barnes); Putnam (MacDougal); Monroe and Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meynecke); Gibson and Posey (Schneck); Kosciusko (Coulter); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

R. HISPIDA (Desv.) Britton. Hispid Yellow Cress.*(Nasturtium palustre hispidum Gray.)*

In wet places in the northern counties, usually in swamps or upon their borders. Not frequent.

Flowers from June through August.
Steuben (Bradner).

R. SESSILIFLORA (Nutt.) A. S. Hitchcock.*(Nasturtium sessiliflorum Nutt.)*

Occurring only in southwestern counties of the State in low grounds.

Flowering season from April to July.

Vigo (Blatchley); Gibson and Posey (Schneck).

R. NASTURTIIUM (L.) Rusby. Water Cress.*(Nasturtium officinale R. Br.)*

Abundant in the northern portions of the State, less frequent in the southern counties. Found in shallow, clear streams and in ditches. The best development is usually found in cool streams near a spring or fed by springs.

Flowers in May and June.

Tippecanoe (Cunningham); Kosciusko (Coulter); Putnam (MacDougal); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Noble (Van Gorder); Daviess (Clements); Fayette (Hessler); St. Joseph (Rothert); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner); Monroe and Vigo (Blatchley).

R. ARMORACIA (L.) A. S. Hitchcock. Horseradish.*(Nasturtium Armoracia Fries.)*

Escaped from cultivation and established in moist, rich ground, in various counties. Reported from Clark (Baird and Taylor); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Noble (Van Gorder); Gibson and Posey (Schneck); Hamilton and Marion (Wilson).

R. AMERICANA (A. Gray) Britton. Lake Cress.*(Nasturtium lacustre Gray.)*

Common in slow streams and in shallow lakes in the western part of the State.

Flowers, June to September.

Tippecanoe (Cunningham); Vigo (Blatchley); Gibson and Posey (Schneck); Vermillion (Wright).

CARDAMINE L.

C. PRATENSIS L. Meadow Bitter Cress. Cuckoo Flower.

This northern form is found in swamps in two of our northern counties, where it blossoms late in April.

Lake (Hill); Noble (Van Gorder).

C. HIRSUTA L. Hairy Bitter Cress.

Found in moist soils, more abundant about springs and along streams. Widely distributed through the State.

It begins to flower in April, and occasionally flowers may be found as late as July.

Kosciusko (Coulter); Daviess (Clements); Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyneke); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Tippecanoe (Hussey); Decatur (Ballard); Hamilton (Wilson); Steuben (Bradner).

C. PURPUREA (Torr.) Britton. Purple Cress.

(*C. rhomboidea purpurea* Torr.)

In wet places on hillsides or in ravines, frequent also in damp open woods. Occasionally found in dry soil.

Among our earliest forms to flower, frequently blossoming early in March, although usually in full bloom over most of our area in April.

Tippecanoe (Cunningham); Daviess (Clements); Monroe and Vigo (Blatchley); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyneke); Noble (Van Gorder); Jefferson (Barnes); Decatur (Ballard); Knox (Spillman); St. Joseph (Rothert); Hamilton and Marion (Wilson).

C. BULBOSA (Schreb.) B. S. P. Spring Cress. Bulbous Cress.

(*C. rhomboidea* DC.)

In low, wet places or damp woods throughout the State. Usually quite abundant.

Flowering season from March to June, the earlier date standing for the extreme southern counties.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (Barnes); Johnson (Hubbard); Monroe and Vigo (Blatchley); Jay, Delaware, Randolph and Wayne (Phinney); Clark (Baird and Taylor); Gibson and Posey (Schneck);

Franklin (Meyncke); Noble (Van Gorder); Fayette (Hessler); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

DENTARIA L.

D. LACINIATA Muhl. Cut-leaved Toothwort or Pepper-root.

Occurring in moist, rich soil throughout the State, usually associated with *Cardamine bulbosa*. Flowering season from April to June. More abundant in the southern part of the State. An exceedingly variable species.

Jefferson (Barnes); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Kosciusko (Coulter); Daviess (Clements); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); St. Joseph (Rothert); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

D. DIPHYLLA Michx

Found only in the southern counties, usually occurring in rich woods. Not abundant in any locality except Monroe County.

Flowers in April and May.

Jefferson (Barnes); Monroe (Blatchley); Clark (Baird and Taylor); Dearborn (Collins); Decatur (Ballard); Steuben (Bradner).

D. HETEROPHYLLA Nutt. Slender Toothwort.

Rare in a few counties in the southern part of the State, occurring in thickets and rich woods.

It flowers very early, the season covering March and April.

Monroe (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Fayette (Hessler).

LEAVENWORTHIA Torr.

L. USIFLORA (Michx) Britton.

(*L. Michauxii* Torr.)

This southern species is confined to the Ohio River counties. The single station from which specimens have been received is Buffalo Lick, near Charlestown, Clark County.

First collected by Dr. Charles R. Barnes.

BURSA Weber.

B. BURSA-PASTORIS (L.) Britton. Shepherd's Purse.
(*Capsella Bursa-pastoris* Moench.)

A very common form throughout the State, chiefly in waste ground and about dwellings. In some cases a very annoying weed in lawns.

It begins to bloom very early, about the first of March, and continues until the most severe frosts. In mild winters it may be found in flower in December and January in sheltered places. Exceeding variable.

Reported from almost every county in the State as "too common."

CAMELINA Crantz.

C. SATIVA (L.) Crantz. False Flax.

Not commonly distributed. Reported only from five counties: Clark (Baird and Taylor); Jefferson (J. M. Coulter); Hamilton (Wilson); Fayette (Hessler); Tippecanoe (Hussey).

It may be expected in fields where flax has been cultivated.

DRABA L.

D. VERNA L. Vernal Whitlow Grass.

One of our smallest flowering plants, occurring in fields and by roadsides in counties south of the center of the State.

It is a winter annual and flowers from February to May.

Jefferson (Coulter); Clark (Baird and Taylor); Putnam (Underwood); Hamilton (Wilson); Marion (Blatchley).

D. CAROLINIANA Walt. Carolina Whitlow Grass.

Also confined to the southern half of the State, excepting one station.

It blossoms in the first warm days late in February or early in March, and its seeds are ripened by April.

It rarely exceeds three inches in height, and, as Professor Blatchley says, "succeeds in the struggle for existence by being first upon the scene of action." It is usually quite abundant in the localities in which it is found.

Vigo (Blatchley); Daviess (Clements); Putnam (Underwood); Hamilton (Wilson); Tippecanoe (Barnes); Lake (Hill).

D. BRACHYCARPA Nutt. Short-fruited Whitlow Grass.

In dry, sandy soil and quite abundant in localities in which it is found.

Habit of growth and flowering season as in preceding species. Gibson and Posey (Schneck); Daviess (Clement); Lake (Hill).

SOPHIA Adans.

S. PINNATA (Walt.) Britton. Tansy Mustard.

(*Sisymbrium canescens* Nutt.)

Occurring in dry soil in several counties. It is often found along railways or in gravel banks bordering streams.

Flowers in June.

Tippecanoe (Cunningham); Vigo (Blatchley); Cass (Hessler); Putnam (MacDougal); Franklin (Meyncke); St. Joseph (Rothert); Knox (Spillman).

STENOPHRAGMA Celak.

S. THALIANA (L.) Celak. Mouse-ear Cress. Wall Cress.

(*Sisymbrium Thaliana* Gaud.)

Specimen from only one station in St. Joseph County, collected by Mr. Otto Rothert. Probably brought in along the railroads from the east. Not spreading.

ARABIS L.

A. VIRGINICA (L.) Trelease. Virginia Rock Cress.

(*A. Ludoviciana* Meyer.)

Formerly quite frequent in the State, especially in southern part. Of late years becoming quite rare.

Flowering season, March to May.

A. LYRATA L. Lyre-leaved Rock Cress.

In sandy soil, and especially abundant along the shores of Lake Michigan, near Michigan City. Confined to northern counties.

Flowering season, April to July.

Lake (Barnes and Hill); Laporte (Barnes); Steuben (Bradner).

A. DENTATA Torr. and Gray. Toothed Rock Cress.

Apparently confined to the southern half of the State and nowhere abundant. In our area it frequents dry, rocky soil, and is more commonly found in open woodland.

Flowers in June.

Dr. Hessler reports it "rather frequent on dry, limestone cliffs and in hilly drift," while Mr. Blatchley reports its occurrence in "rocky woods."

Vigo and Monroe (Blatchley); Cass (Hessler); Franklin (Meyncke); Jay, Delaware, Randolph and Wayne (Phinney); Gibson (Schneck); Decatur (Ballard); Hamilton (Wilson).

A. PATENS Sulliv. Spreading Rock Cress.

Sparsely distributed through the State.

Commencing to flower in the southern counties in April, in the northern in May.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Decatur (Ballard).

A. HIRSUTA (L.) Scop. Hairy Rock Cress.

Occurring on rocky hillsides or dry, gravelly soil in several counties of the State.

Flowers in April and May.

Vigo, Monroe and Montgomery (Blatchley); Putnam (MacDougal); Cass (Hessler); Noble (Van Gorder).

I have never seen the plant growing, and the data as to soil habits are taken from Mr. Blatchley.¹

A. LAEVIGATA (Muhl.) Poir. Smooth Rock Cress.

On rocky hillsides and in ravines and thin woods.

Flowers in May and June, although in favored localities it may bloom in April.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Vermillion (Wright); Decatur (Ballard); Hamilton (Wilson).

A. CANADENSIS L. Sickle-pod.

A form found only in sand or gravel soils, in rather shaded positions.

Flowers somewhat later than other forms, June being the time over the greater part of its area.

Tippecanoe (Cunningham); Vigo (Blatchley); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); Jay, Delaware, Randolph and Wayne (Phinney); Lake (Hill); Steuben (Bradner).

¹Blatchley, W. S. A Catalogue of the Uncultivated Ferns and Flowering Plants of Vigo County, Indiana. 21st Geol. Rept., 1896, p. 635.

A. BRACHYCARPA (T. and G.) Britton. Purple Rock Cress.

Probably a migrant, coming into our flora from the north.

Reported from Tippecanoe (Barnes); Decatur (Ballard). Occurring also in the dune flora of Lake and Porter counties.

A. GLABRA (L.) Beruh. Tower Mustard.

(*A. perfoliata* Lam.)

Reported as occurring along railroad in Putnam County by Dr. MacDougal. Verifying specimens in DePauw herbarium. Probably a migrant.

Steuben (Bradner).

ERYSIMUM L.

E. ASPERUM DC. Western Wall Flower. Yellow Phlox.

This showy crucifer is becoming more abundant and of more general distribution. In some localities it is so abundant as to give brilliant mass effects. It frequents gravelly soils or limestone cliff. Growing well in very light, thin soils.

Flowers in May and June.

Tippecanoe (Cunningham); Montgomery (Coulter); Cass (Hessler); Vigo (Blatchley); Putnam (MacDougal).

CAPPARIDACEÆ. Caper Family.

CLEOME L.

C. SPINOSA L. Spider-flower.

A southern form which has either escaped from cultivation in the southern part of the State, or found its way into our flora by way of the Wabash River. Sparingly found in waste places. Whether migrant or escape, it maintains itself well.

Flowering from June until in September.

Clark (Baird); Gibson and Posey (Schneck).

POLANISIA Raf.

P. GRAVEOLENS Raf. Clammy-weed.

Rather common in most parts of the State in dry, sandy or gravelly soil. More abundant in shore sand and gravel in places removed from the immediate action of the water.

Flowers from June until in September.

Bartholomew (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clemons); Montgomery; Marion (Wilson); Jennings (Barnes).

SARRACENIACEÆ. Pitcher-plant Family.

SARRACENIA L.

S. PURPUREA L. Pitcher-plant. Side-saddle Flower. Indian Cup.

In the northern counties of the State in peat bogs. Very common in the stations in which it is found. The hollow leaves are ordinarily about two-thirds full of water containing drowned insects.

Flowers from late in May until August.

Fulton and Marshall (Hessler); Laporte (Barnes); Kosciusko (Coulter); Noble (Van Gorder); Lake (Hill); Steuben (Bradner).

DROSERACEÆ. Sundew Family.

DROSERIA L.

D. ROTUNDIFOLIA L. Round-leaved Sundew.

In sphagnum swamps and bogs in a few of the northern counties. Frequent, but not abundant.

Flowers in July and August.

Fulton (Blatchley); Kosciusko (Coulter); Lake; Steuben (Bradner).

D. INTERMEDIA Hayne. Spatulate-leaved Sundew.

In similar situations as the preceding, but not so abundant.

Flowers in July and August.

Lake.

CRASSULACEÆ. Orpine Family.

SEDUM.

S. TELEPHIUM L. Live-forever.

In waste places and along roadsides in dry soils. Neither abundant nor widely distributed.

Flowers from June until October.

Noble (Van Gorder); Franklin (Meyneke); Hamilton (Wilson); Steuben (Bradner).

S. TELEPHIODES Michx.

In southern counties only, on dry rock or on rocky hillsides. Not common.

Flowers from June through September.

Clark (Barnes); Vigo (Blatchley).

S. ACRE L. Wall Pepper. House-leek.

Escaped from cultivation and found in dry, rocky places, in a few localities.

Flowers from June through August.

Gibson and Posey (Schneck); Noble (Van Gorder).

S. TERNATUM Michx. Wild Stonecrop.

Found throughout the State, except perhaps in the extreme northern counties. It is found usually on rocks or in rocky soils of banks and ravines. As a rule, it is not abundant in any of its stations.

Flowers from May through August.

Monroe and Vigo (Blatchley); Fayette (Hessler); Jay, Delaware, Randolph and Wayne (Phinney); Clark (Baird and Taylor); Dearborn (Collins); Franklin (Meyneke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Putnam (MacDougal); Decatur (Ballard); Hamilton and Marion (Wilson).

PENTHORUM L.

P. SEDOIDES L. Ditch Stonecrop.

In all parts of the State, growing abundantly in low, wet places. Especially plentiful about swamps and along ditches.

Flowers from July until October.

Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Daviess (Clements); Jay, Delaware, Randolph and Wayne (Phinney); Franklin (Meyneke); Jefferson (J. M. Coulter); Noble (Van Gorder); Posey (Schneck); Knox (Spillman); Tippecanoe (Cunningham); Hamilton and Marion (Wilson); Kosciusko (Coulter); Putnam (MacDougal); Hamilton (Wilson); Steuben (Bradner).

SAXIFRAGACEÆ. Saxifrage Family.

SAXIFRAGA L.

S. PENNSYLVANICA L. Swamp Saxifrage.

In many counties of the State, but nowhere abundant. The species grows in swamps or in wet woods and prairies. More frequent in the northern part of the State.

Flowering in May and early June.

Cass (Hessler); Tippecanoe (Hussey); Vigo (Blatchley); Putnam (MacDougal); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); St. Joseph (Rothert); Hamilton (Wilson); Steuben (Bradner); Marion; Lake (Hill).

S. VIRGINIENSIS Michx. Early Saxifrage.

A few forms occur in southeastern Indiana on rocky hillsides and limestone ledges. An exceptional form in our area.

Flowering specimens collected April 19.

Dearborn (Collins).

SULLIVANTIA Torr. and Gray.

S. SULLIVANTII (T. and G.) Britton.

(*S. Ohionis* T. and G.)

Confined to the southern counties of the State, where it is found abundantly in a few stations. With us it is strictly a plant of limestone cliffs. It grows well up the vertical cliff walls, securing a foothold in the thinnest layers and smallest pockets of soil. It was first detected at Clifty Falls in Jefferson County, by Dr. John M. Coulter, in 1874, since which time two other stations have been located, the plant never being in any other situation than on limestone cliffs.

Flowers in June.

Jefferson and Floyd (Barnes); Clark (Baird and Taylor); Carroll.

TIARELLA L.

T. CORDIFOLIA L. False Mitrewort.

In a few counties of the State, occurring sparingly in rich, moist woods. A delicate form perhaps mistaken for *Mitella*.

Flowering in April and May.

Jay, Delaware, Randolph and Wayne (Phinney); St. Joseph.

HEUCHERA L.

H. VILLOSA Michx. Hairy Sanicle.

Only found in the southern counties of the State, where it grows in sparing numbers on rough hillsides in coarse soils.

Flowering from June through August.

Clark (Barnes).

H. AMERICANA Pursh. Alum root.

Widely distributed throughout the State; frequent, but never occurring in large numbers. Usually found in dry, coarse and even rocky soils.

Flowers from May until September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Jefferson (Barnes); Putnam (MacDougall); Jay, Delaware, Randolph and Wayne (Phinney); Clark (Baird and Taylor); Gibson and Posey (Schneck); Noble (Van Gorder); Franklin (Meyncke); Monroe and Vigo (Blatchley); Steuben (Bradner); Fayette (Hessler).

H. HISPIDA Pursh. Rough Heuchera.

Found in dense, damp woods in a few counties. It is found in sparing numbers, but is probably of wider distribution than the citations would indicate.

Flowering in May and June.

Marshall and Vigo (Blatchley); Lake (Hill).

MITELLA L.

M. DIPHYLLOIDES L. Mitre-wort. Bishop's Cap.

In many counties of the State in fair abundance; growing in rich, moist soils in woods and shaded ravines. An easily recognized and pretty species.

Flowering in April and May.

Monroe and Vigo (Blatchley); Fayette (Hessler); Jay, Delaware, Randolph, and Wayne (Phinney); Putnam (MacDougal); Jefferson (Barnes); Tippecanoe (Cunningham); Noble (Van Gorder); Clark (Baird and Taylor); St. Joseph (Rothert); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

PARNASSIA L.

P. CAROLINIANA Michx. Grass of Parnassus.

Confined to the northern counties of the State, where it is of fair abundance in marshes and in low, wet bottom lands.

Flowers from late in June through September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Marion and Marshall (Blatchley); Cass (Hessler); Noble (Van Gorder); Steuben (Bradner); Lake (Hill).

HYDRANGEA L.

H. ARBORESCENS L. Wild Hydrangea.

In many parts of the State on rocky banks of streams or on damp hillsides where the soil is coarse. Found frequently in the southern counties, less plentiful farther north, not being reported as occurring north of Tippecanoe County.

Flowers in June and July. In favorable seasons a second blooming occurs in September.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Dearborn (Collins); Gibson and Posey (Schneck); Franklin (Meyncke); Clark (Baird and Taylor); Jay, Delaware, Randolph and Wayne (Phinney); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson).

GROSSULARIACEÆ. Gooseberry Family.

RIBES L.

R. CYNOSBATI L. Wild Gooseberry. Spiny Gooseberry.

The common wild form of our area, found in most parts of the State growing in woods or along the banks of streams usually in coarse, rocky soils.

Flowers from early April through June.

Tippecanoe (Cunningham); Kosciusko (Coulter); Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Jay, Delaware, Randolph and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke); Noble (Van Gorder); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

R. GRACILE Michx. Missouri Gooseberry.

Found in several counties of the State, usually growing in shaded locations in dry, coarse soils. It is without doubt much more widely distributed than the citations indicate, having been referred in many cases to *R. rotundifolium*.

Flowers in May.

Tippecanoe (Cunningham); Kosciusko (Coulter); Vigo (Blatchley).

R. OXYACANTHOIDES L. Northern Gooseberry.

Not abundant but found in a few counties in wet soil, either in light, open woods or in bottom land thickets.

Flowering season, May and June.

Noble (Van Gorder); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Vigo (Blatchley); Steuben (Bradner).

R. ROTUNDIFOLIUM Michx.

All of the specimens labelled *R. rotundifolium* that have come to my notice are to be referred to *R. gracile*. In the hill regions of the counties fronting the Ohio River, however, the species is found upon the authority of Dr. J. M. Coulter.

Flowering in May and June.

Clark (Baird and Taylor); Jefferson (J. M. Coulter).

R. FLORIDUM L'Her. Wild Black Currant.

Throughout the State in sparing numbers, growing in damp woods.

Flowers in April and May.

Franklin (Meyncke); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Montgomery (Olive); Madison (Walker); Knox Spillman); Cass (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner); Lake (Blatchley).

R. RUBRUM L. Red Currant.

(*R. rubrum subglandulosum* Maxim.)

Freely escaped from cultivation in the southern counties, but not yet reported from north of the tier of counties fronting the Ohio River. Included in Gray's Manual, sixth edition, as occurring in Indiana, doubtless from these citations.

Flowers in May and June.

Clark (Baird and Taylor); Jefferson (J. M. Coulter); Laporte.

HAMAMELIDACEÆ. Witch Hazel Family.

HAMAMELIS L.

H. VIRGINIANA L. Witch Hazel.

Found throughout the State in greater or less abundance in damp woods and thickets. In our area it is a shrub rarely exceeding six or eight feet in height.

Flowers from October through December, the fruit maturing in the early spring months.

Kosciusko (Coulter); Laporte (Barnes); Jefferson (J. M. Coulter); Tippecanoe (Hussey); Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Franklin (Meyncke); Monroe and Vigo (Blatchley); Cedar Lake (Deam); Hamilton (Doane); Putnam (MacDougal); Steuben (Bradner).

LIQUIDAMBAR L.

L. STYRACIFLUA L. Sweet Gum. Red Gum.

Common in the southern part of the State, becoming much less frequent toward the north. It frequents low, rich soils, in which it at times reaches a height of nearly 150 feet. Its wood is hard but not strong, and is but little used in manufacturing on account of its seasoning with difficulty. It may be recognized at a distance in the fall by its brilliant coloration. Its gum has a certain commercial value as a substitute for storax.

It flowers in April and May.

The range includes probably almost all of the southern counties. The stations definitely reported are as follows:

Kosciusko (Coulter); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Monroe and Vigo (Blatchley); Decatur and Shelby (Ballard).

PLATANACEÆ. Sycamore or Plane Tree Family.

PLATANUS L.

P. OCCIDENTALIS L.

This well-known tree is very generally distributed along waterways. In favorable locations it ranges in height from 100 to 120 feet and in diameter from seven and one-half to thirteen feet, sometimes exceeding these dimensions. The larger trees are, however, for the most part, hollow, for at least the length of the first cut. The tree also is becoming common in wet soils along roads and in fields. In these more open places it is a gracefully-shaped tree and very ornamental, both in summer with its large leaves and in winter when thickly hung with its fruiting heads.

The wood is heavy and hard, but not strong, and exceedingly difficult to split and work. It is largely used for tobacco boxes, yokes and butcher blocks, and to a certain extent in the manufacture of cheap furniture.

Its chief value is perhaps to be found, because of its rapid growth, in the recovering of denuded wet soils.

Flowering season in May.

It is practically found in every part of the State, so that specific stations need not be given.

ROSACEÆ. Rose Family.

OPULASTER Medic.

O. OPULIFOLIUS (L) Kuntze. Ninebark.

(*Physocarpus opulifolius* Maxim.)

Chiefly in the southern counties, growing on rocky banks along streams. Reported as rare as far north as Cass County. A rather handsome shrub from five to eight feet high, the bark peeling off in thin strips.

Flowers in June.

Gibson and Posey (Schneck); Dearborn (Collins); Wayne (Phinney); Franklin (Meyncke); Monroe, Marion and Wabash (Blatchley); Cass (Hessler); Jefferson (J. M. Coulter); Hamilton (Wilson).

SPIRÆA L.

S. SALICIFOLIA L. Meadow Sweet.

Common in low, wet grounds and swamps in many counties in the State. A handsome shrub from two to four feet high, with the white or rose-tinted flowers in dense panicles.

Flowering from June through August.

Tippecanoe, Laporte, Elkhart and Jefferson (Barnes); Cass (Hessler); Lagrange and Vigo (Blatchley); Jay, Delaware, Randolph and Wayne (Phinney); Clark (Baird and Taylor); Gibson and Posey (Schneck); Noble (Van Gorder); Monroe (Dudley); Cedar Lake (Deam); Steuben (Bradner).

S. TOMENTOSA L. Hardhack. Steeple-bush.

Less widely distributed than the former, but quite common in the southern counties. Found growing in wet situations. A handsome shrub with purple flowers gathered in dense panicles. Both species of this genus are worthy of cultivation as ornamental shrubs.

Flowers from July until October.

Kosciusko (Coulter); Daviess (Clements); Cass (Hessler); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); Steuben (Bradner).

ARUNCUS Adans.

A. ARUNCUS (L.) Karst. Goat's-beard.

(*Spiraea Aruncus* L.)

Frequent in many counties growing in rich, damp soils. Most frequently found on banks and bluffs of streams.

Flowers from May through July.

Kosciusko (Coulter); Monroe (Blatchley); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor).

PORTERANTHUS Britton.

P. TRIFOLIATUS (L.) Britton. Indian Physic. Bowman's Root.

(*Gillenia trifoliata* Moench.)

In rich soils in shaded places in the southern counties. Probably of somewhat wider distribution than the citations indicate.

Flowers in May and June.

Gibson and Posey (Schneck); Clark (Baird and Taylor).

P. STIPULATUS (Muhl.) Britton. American Ipecac.
(*Gillenia stipulacea* Nutt.)

In similar situations as the preceding, though of somewhat wider range in the State, being reported as far north as Tippecanoe County. It closely resembles the preceding species in general aspect, the most striking difference being in the pubescence and size of stipules.

Flowers in June and July.

Tippecanoe and Floyd (Barnes); Clark (Baird and Taylor); Gibson (Schneck).

RUBUS L.

R. STRIGOSUS Michx. Wild Red Raspberry.

In dry, rather rocky soils in many counties of the State. The species does not occur in especial abundance in any of its stations, but is not infrequent. "The original of the Cuthbert and Hansall raspberries" (Britton and Brown).

Flowers in May and June; fruit ripens in July and August.

Tippecanoe (Cunningham); Putnam (MacDougal); Jay, Delaware, Randolph and Wayne (Phinney); Dearborn (Collins); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); Marion; Steuben (Bradner).

R. OCCIDENTALIS L. Black Raspberry.

Of wide range and quite abundant throughout the State. This species is the common form in the State, growing freely at the borders of fields and thickets and in waste places. The fruit is quite largely marketed. "The original of the Gregg, Hilborn and other raspberries" (Britton and Brown).

Flowers in April and May; fruit ripens in July.

Tippecanoe (Cunningham); Kosciusko (Coulter); Putnam (MacDougal); Jefferson (Barnes); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); Dearborn (Collins); Monroe and Vigo (Blatchley); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

R. AMERICANUS (Pers.) Britton. Dwarf Raspberry.*(R. triflorus Richards.)*

This northern form is reported only from the northern tier of counties, where it is found in swamps and wet places. Abundant locally.

Flowers in May and June; fruit ripens in July and August.

Lake (Hill); Steuben (Bradner).

R. VILLOSUM Ait. High Bush Blackberry.

The common form in the State; very abundant and very variable. It is usually found in dry soils and frequently covers wide areas to the almost entire exclusion of other plants. The quality of the fruit varies with its situation, being as a rule larger, more pulpy and sweeter when growing in shaded places. The berries are shipped from the southern counties of the State by carloads.

Flowers in May and June; fruit ripens in July and August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Jefferson (Barnes); Putnam (MacDougal); Monroe and Vigo (Blatchley); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); Dearborn (Collins); Knox (Spillman); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

R. HISPIDUS L. Running Swamp Blackberry.

In marshes and low grounds; also in damp, flat woods, usually in grassy places. Not abundant. The berry consists of but a few grains.

Flowers in May and June.

Jefferson (Barnes); Clark (Baird and Taylor); Noble (Van Gorder); Monroe and Vigo (Blatchley); Steuben (Bradner).

R. BAILEYANUS Britton.*(R. villosus humifusus T. and G.)*

A trailing form found in sandy soil in the southern counties. Difficult to separate from *R. Canadensis*, with which it intergrades.

Flowers in May and June; fruit ripens in July.

Monroe and Vigo (Blatchley); Hamilton and Marion (Wilson); Gibson and Jefferson.

R. CANADENSIS L. Dewberry. Low Blackberry.

A trailing form found in rocky situations or in coarse gravel soils in many parts of the State; especially abundant southward. The fruit is much sweeter and of better flavor than that of *R. villosus*, but is too soft to bear long shipments.

Flowers in April and May; fruit ripens early in July.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Putnam (MacDougal); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); St. Joseph (Rothert); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner); Cass (Hessler).

FRAGARIA L.

F. VIRGINIANA Duchesne. Scarlet Strawberry.

This includes all forms referred to *F. Virginiana Illinoensis* Gray. The plant is found in all parts of the State, though rarely in great abundance. In our area it is usually found in moist, rich, shaded places, although at times growing in dry soils.

Flowers from April through June.

Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Franklin (Meyncke); Dearborn (Collins); Tippecanoe (Cunningham); Daviess (Clements); Fayette (Hessler); Knox (Spillman); Kosciusko (Coulter); Decatur and Shelby (Ballard); Marion; Steuben (Bradner); Monroe.

F. VESCA L. European Wood Strawberry.

Found in several counties, chiefly southern, growing in dry, sandy or gravelly soils. Quite frequent in the stations in which it occurs.

Flowers in April and May.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Clark (Baird and Taylor); Hamilton and Marion (Wilson).

POTENTILLA L.

P. ARGUTA Pursh. Tall Cinquefoil.

In dry upland soils, chiefly sandy or gravelly, in the northern part of the State.

Flowers in June and July.

Steuben (Bradner).

P. ARGENTEA L. Hoary Cinquefoil.

In dry, sandy soils in the northern counties of the State. Not of common occurrence.

Flowers from May through August.

St. Joseph (Barnes); Noble (Van Gorder); Lagrange (Blatchley); Steuben (Bradner).

P. MONSPELIENSIS L. Rough Cinquefoil.

(*P. Norvegica* L.)

Widely distributed and generally abundant. In cultivated fields it is frequently an annoying weed. More plentiful in the northern than in the southern counties.

Flowers from June through August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Cass and Fayette (Hessler); Jefferson (J. M. Coulter); Gibson (Schneck); Jay, Delaware, Randolph and Wayne (Phinney); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); Vermillion (Wright); Monroe and Vigo (Blatchley); Putnam (MacDougal); Steuben (Bradner).

P. FRUTICOSA L. Shrubby Cinquefoil.

Common in rich alluvial soils in the northern counties. Chiefly found near marshes and in the lowlands about lakes. Very troublesome in low fields in many places.

Flowers from June through September.

Kosciusko (Coulter); Cass (Hessler); Lagrange (Blatchley); Noble (Van Gorder); Lake; Steuben (Bradner).

P. ANSERINA L. Goose-tansy.

Found only along the southern shores of Lake Michigan as a constituent of the flora of the sand dunes.

Flowers from May through August.

Lake (Hill); Porter (Cowles).

P. CANADENSIS L. Five-finger.

Common in dry soils throughout the State. It is very abundant in wornout or exhausted fields, frequently covering acres. Locally it is more commonly known as "wild strawberry." Its habit of spreading by runners usually insures a wide extension where it has obtained a foothold.

Flowers from May through July.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Cowles); Jefferson (Barnes); Putnam (MacDougal); Jay, Dela-

ware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); Dearborn (Collins); Vermillion (Wright); Monroe and Vigo (Blatchley); Fayette (Hessler); Knox (Spillman); St. Joseph (Rothert); Hamilton and Marion (Wilson).

COMARUM L.

C. PALUSTRE L. Marsh Five-finger.

(*Potentilla palustris* Scop.)

In sphagnum swamps and peat bogs in a few of the northern counties. Frequent but not abundant. Our northern counties represent about the southern limit of the species.

Flowers in June and July.

Lake and St. Joseph (Blatchley); Noble (Van Gorder); Steuben (Bradner); Marshall (Hessler).

WALDSTEINIA Willd.

W. FRAGARIOIDES (Michx.) Tratt. Barren Strawberry.

Occasional in woods and on shaded hillsides in the central and southern counties of the State. No definite reports of stations are in my hands, but several herbarium specimens attest its presence in the State.

Flowering season, May and June.

GEUM L.

G. RIVALE L. Purple or Water Avens.

This interesting northern form was added to the State flora by Mr. W. B. Van Gorder, who collected it in swamp regions in northern Indiana. It will probably be found in similar situations in other northern counties.

Collected in flower June 17.

Noble (Van Gorder).

G. VERNUM (Raf.) T. and G. Spring Avens.

Widely distributed through the State in low, wet grounds in shaded places. Usually abundant in the stations in which found.

Flowers from May until August.

Tippecanoe (Cunningham); Jefferson (Barnes); Vigo and Monroe (Blatchley); Putnam (MacDougal); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Daviess (Clements); Fayette (Hessler); Knox (Spillman); Hamilton and Marion (Wilson).

G. CANADENSE Jacq. White Avens.*(G. album* Gmelin.)

Borders of woods and thickets in shaded places, throughout the State. Abundant wherever found.

Flowers from May through August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Jay, Delaware, Randolph and Wayne (Phinney); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); Monroe and Vigo (Blatchley); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

G. VIRGINIANUM L. Rough Avens.

In low, wet grounds in many counties of the State. Usually abundant in stations where found.

Flowers in May and June.

Kosciusko (Coulter); St. Joseph (Barnes); Jay, Delaware, Randolph and Wayne (Phinney); Jefferson (J. M. Coulter); Noble (Van Gorder); Franklin (Meyncke); Fayette (Hessler); Knox (Spillman); Steuben (Bradner).

G. MACROPHYLLUM Willd. Large-leaved Avens.

Reported from the southern part of the State as occurring at the borders of open, rich woods.

Flowering specimens collected in June.

Vigo (Blatchley).

G. STRICTUM Ait. Yellow Avens.

In low, damp grounds and in the borders of marshes in various counties. Not abundant in any of its stations.

Flowers in June and July.

Kosciusko (Coulter); Jefferson (Barnes); Clark (Baird and Taylor); Tippecanoe (Cunningham); Steuben (Bradner).

ULMARIA Hill.

U. RUBRA Hill. Queen-of-the-Prairie.*(Spiraea lobata* Jacq.)

Found in various counties of the State in wet places about lakes and in damp meadows and prairies.

Flowers in June and July.

Tippecanoe (Cunningham); Cass (Hessler); Wabash and Vigo (Blatchley); Jefferson (J. M. Coulter); Jay, Delaware, Randolph and Wayne (Phinney); Scott; Marion (Wilson).

AGRIMONIA L.

A. MOLLIS (T. and G.) Britton. Soft Agrimony.*(A. Eupatoria mollis* T. and G.)

Common in many parts of the State in dry soils. Frequent in thickets and along fence rows, as well as in light woods.

Flowers from June through August.

Monroe and Vigo (Blatchley); Fayette (Hessler); Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Putnam (MacDougal); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Noble (Van Gorder); Gibson and Posey (Schneck).

A. PARVIFLORA Soland. Small-flowered Agrimony.

In many parts of the State in various situations. At times it is found as a dominant plant in low, alluvial lands about lakes. It is also of frequent occurrence along gravelly banks and on roadsides.

Flowering season, July through September.

Kosciusko (Coulter); Noble (Van Gorder); Clark (Baird and Taylor); Gibson and Posey (Schneck); Monroe and Vigo (Blatchley); Fayette (Hessler); Jefferson, Hamilton and Marion (Wilson); Steuben (Bradner).

A. STRIATA Michx. Woodland Agrimony.

Frequent in Hamilton and Marion counties in dry woods, upon the authority of Mr. G. W. Wilson.

Flowers in July and August.

SANGUISORBA L.

S. CANADENSIS L. Great Burnet.*(Poterium Canadense* Gray.)

Found sparingly in southern part of the State by "borders of ditches and prairies in moist soil." (Blatchley.) Records of the occurrence of this form are rare, although the species is of somewhat frequent occurrence in the southern counties.

Flowers from August until October.

Vigo (Blatchley).

ROSA L.

R. SETIGERA Michx. Climbing Rose. Prairie Rose.

Borders of thickets and in open places in many counties of the State. Usually found in soil of good quality.

Flowers in June and July.

Tippecanoe (Cunningham); Kosciusko (Coulter); Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Putnam (MacDougal); Clark (Baird and Taylor); Franklin (Meyncke); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Steuben (Bradner).

R. BLANDA Ait. Smooth or Meadow Rose.

In a few localities in the rocky hills of southern counties. Found in damp, rather cold soil.

Flowering in June and July.

Dearborn (Collins); Clark (Baird and Taylor).

R. ACICULARIS Lindl. Prickly Rose.

R. Englemanni S. Wats.

Reported from Lake County by Rev. E. J. Hill and from Lake and Porter counties by Dr. H. C. Cowles. The species is quite abundant in these two counties but has not been reported from any other counties in the State.

Flowers in June and July.

R. CAROLINA L. Swamp Rose.

Rather common in various parts of the State, growing in dense clumps at times in the borders of swamps and in low, wet grounds.

Flowering season, from June through August.

Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Noble (Van Gorder); Vigo and Monroe (Blatchley); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

R. HUMILIS Marsh. Pasture Rose.

Frequent in the southern counties of the State in dry, usually sandy or gravelly soils. At times the species almost entirely covers dry, sterile embankments.

Flowers from May until late in July.

Daviess (Clements); Monroe and Vigo (Blatchley); Knox (Spillman).

R. HUMILIS LUCIDA (Ehrh) Best.*(R lucida Ehrh)*

Much more widely distributed and more abundant than the type. In our area, this is our common wild rose. Found in various situations, but most frequently in dry, sandy or rocky soils.

Flowers from May until in July.

St. Joseph (Barnes); Monroe (Blatchley); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Franklin (Meyncke); Noble (Van Gorder); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Vermillion (Wright); Daviess (Clements); Tippecanoe (King); Hamilton and Marion (Wilson); Steuben (Bradner).

R. RUBIGINOSA L. Sweet Briar.

Frequent in the southern counties, becoming less frequent northward. Found in waste places and along roadsides in dry soil.

Flowering season, from June through August.

Jefferson (Barnes); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Gibson and Posey (Schneck); Dearborn (Collins); Monroe and Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner); Fayette (Hessler).

R. NITIDA Willd. Northeastern Rose.

Found somewhat sparingly throughout the State, growing in low, damp grounds. While frequently met, it is never so abundant as some of the other species of the genus.

Flowers in June and July.

POMACEÆ. Apple Family.**MALUS Juss.****M. ANGUSTIFOLIA (Ait.) Michx. Narrow-leaved Crab Apple. Southern Crab Apple.***(Pyrus angustifolia Ait.)*

Found sparingly in the southern part of the State, growing in rather dry thickets and woods. A small tree reaching a height of from fifteen to twenty feet and a diameter of from six to ten inches.

Flowering season, April and May.

Jefferson (Barnes); Gibson and Posey (Schneck).

M. CORONARIA (L.) Mill. American or Wild Crab Apple.*(Pyrus coronaria L.)*

This species is widely distributed through the State, being especially abundant in the southern counties. It is found in various soils, but reaches its best development in rich, low woods. Largely cultivated because of its fragrance in flowering season. The wood, which is hard and heavy, is somewhat used in making handles for tools.

Flowers in April and May.

Tipecanoe and Kosciusko (Coulter); Jefferson (Barnes); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Franklin (Meyncke); Noble (Van Gorder); Vermillion (Wright); Knox (Spillman); Monroe and Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner); Fayette (Hessler).

ARONIA Pers.**A. ARBUTIFOLIA (L.) Ell. Red Chokeberry. Dogberry.***(Pyrus arbutifolia L. F.)*

In marshy regions or damp woodlands in many counties of the State. A branching shrub of from six to eight feet in height, bearing a bright red fruit.

Flowering season, from March until in May.

Jefferson (J. M. Coulter); Vigo (Blatchley); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney).

A. NIGRA (Willd.) Britton. Black Chokeberry.*(Pyrus arbutifolia melanocarpa Hook.)*

Found less commonly than the preceding and less widely distributed. Found in lowlands. Fruit a purple black at maturity.

Flowers from April through June.

Cass (Hessler); Steuben (Bradner); Lake and Fulton (Blatchley).

AMELANCHIER Medic.**A. CANADENSIS (L.) Medic. June Berry. Service Berry.**

Generally distributed throughout the State, but nowhere frequent. Found usually in dry situations.

Flowers from March until May; fruit ripens in July.

Tipecanoe (Cunningham); Cass (Hessler); Monroe (Blatchley); Putnam (MacDougal); Noble (Van Gorder); Jefferson (J. M. Coulter); Jay (Phinney); Franklin (Meyncke); Hamilton (Wilson); Steuben (Bradner); Lake.

A. BOTRYAPIUM (L. f.) DC. Shad Bush.*(A. Canadensis oblongifolia T. and G.)*

In swamps and low soil in various parts of the State. Also found in rocky soil and on limestone cliffs. Frequent but nowhere abundant. Its habit with us is that of a shrub, although it sometimes reaches a height of twenty-five feet. The wood is very hard and susceptible of a high polish, but is not used in manufactures.

Flowers in April and May; fruit ripens in July.

Cass (Hessler); Monroe and Vigo (Blatchley); Lake, Delaware, and Randolph.

A. ROTUNDIFOLIA (Michx.) Roem.*(A. Canadensis rotundifolia Michx.)*

Found sparingly in woods and thickets in the northern counties.

Fruit ripens in August.

Steuben (Bradner); Lake (Blatchley).

CRATÆGUS L.**C. CRUS-GALLI L. Cockspur Thorn.**

Found throughout the State in thickets and woodlands. One of the most common species of this very puzzling genus. A large shrub with numerous, slender thorns from two to four inches in length.

Flowers in May and June.

Tippecanoe (Cunningham); Kosciusko (Coulter); Jefferson (Barnes); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Monroe and Vigo (Blatchley); Putnam (MacDougal); Knox (Spillman); Hamilton (Wilson).

C. PUNCTATA Jacq. Large-fruited Thorn.

Less widely distributed than the preceding, but quite abundant in the localities in which it is found. Found in thickets and on open wooded slopes. Fruit nearly an inch in diameter, red or yellow at maturity.

Flowers in May and June.

Tippecanoe (Cunningham); Putnam (MacDougal); Jefferson (Barnes); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Monroe and Vigo (Blatchley); Decatur (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

C. COCCINEA L. Red Haw.

Found abundantly in all parts of the State. It grows in various situations, but reaches its best development in low, rich soils in shaded places. It is found generally as a small tree, though frequently occurring as a shrub. The fruit is about a half-inch in diameter and red at maturity. It ripens in August, but is more or less astringent in taste.

Flowers in April and May.

Tippecanoe (Cunningham); Kosciusko (Coulter); Jennings (Barnes); Jefferson (J. M. Coulter); Vigo and Monroe (Blatchley); Putnam (MacDougal); Noble (Van Gorder); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Dearborn (Collins); St. Joseph (Rothert); Hamilton and Marion (Wilson); Steuben (Bradner).

C. ROTUNDIFOLIA (Ehrh.) Borck. Glandular Thorn.

Much resembling the preceding species, but with smaller leaves and more slender spines.

Flowers in April and May. First separated from *C. coccinea* by Mr. Blatchley.

Marion County.

C. MOLLIS (T. and G.) Scheele. Red-fruited Thorn.

(*C. coccinea mollis* T. and G.)

Confined to the southern counties of the State where it is found growing along the borders of streams and on open hillsides in rich soil. Not abundant. Similar in habit to the preceding species.

Flowers in April and May; fruit ripens in July.

Jefferson (Barnes); Gibson (Schneck); Monroe and Vigo (Blatchley); Marion, Hamilton (Wilson); Steuben (Bradner); Elkhart.

C. TOMENTOSA L. Black Haw. Pear Haw.

Well distributed throughout the State, usually growing in rich soils along streams and often forming dense thickets. Either a shrub or small tree. Wood hard and heavy, but of no economic value.

Flowers in May and June.

Elkhart and Jefferson (Barnes); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Gibson and Posey (Schneck); Monroe and Vigo (Blatchley); Marion; Hamilton (Wilson); Steuben (Bradner).

C. FLAVA Ait. Summer or Yellow Haw.

This species is of occasional occurrence in the State. Specimens received from the southeastern part of the State during the past season are to be referred to this species. Its occurrence in our area is exceptional. It grows in dry, sandy soil, in shaded places.

Flowering specimens collected in May.

Dearborn (Collins).

DRUPACEÆ. Plum Family.**PRUNUS L.****P. AMERICANA Marsh. Wild Yellow or Red Plum. Horse Plum.**

Well distributed through the State, but nowhere especially abundant. It is usually found along streams in rich soils. It rarely exceeds a trunk diameter of twelve inches. The wood is very strong and susceptible of a high polish. It is largely used in the manufacture of handles for tools.

Flowers in April and May; fruit ripens in August and September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Cass (Hessler); Jefferson (Barnes); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Noble (Van Gorder); Franklin (Meyneke); Monroe and Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

P. ANGUSTIFOLIA Michx.

(*P. Chicasa Michx.*)

Of rare occurrence in the southwestern counties of the State. It is reported as growing on dry, rather rocky slopes. I have seen no specimens and the species is admitted upon the authority of the collectors.

Flowers in April; fruit ripens in July.

Gibson (Schneck).

P. PUMILA L. Sand Cherry. Dwarf Cherry.

Found only on the southern shore of Lake Michigan. The species is a member of the dune flora, and according to Dr. Cowles plays a certain part as a dune builder.

Flowers in April and May; fruit ripens in August.

Porter (Cowles); Lake.

P. PENNSYLVANICA L. f. Wild Red Cherry.

Exceptionally found in a few counties of the State, in dry, coarse soils. Usually not exceeding twenty-five feet in height.

Flowering in May and June; fruit ripens in August.

Kosciusko (Chipman); Jay, Delaware, Randolph, and Wayne (Phinney).

P. VIRGINIANA L. Choke Cherry.

Not abundant, but reported from many counties. It is found along the rocky banks of streams and on limestone bluffs. In our area it only exceptionally takes on the arborescent habit usually occurring as a small shrub from six to eight feet in height.

Flowers in April and May; fruit ripens in August.

Cass (Hessler); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Monroe (Blatchley); St. Joseph (Rothert); Marion and Tippecanoe; Steuben (Bradner).

P. SEROTINA Ehrh. Wild Black Cherry. Rum Cherry.

A tree quite largely distributed throughout the State. It reaches its largest size perhaps in rich upland soils in the southern counties of the State. Its great value in interior finish and cabinet work is rapidly thinning out the larger specimens, and in some counties where once abundant it is almost extinct. The wilted leaves and twigs of this species if eaten by stock produce serious and even fatal cases of poisoning. The bark is largely used medicinally, and the fruit is in some localities used for the table.

Flowers in May; fruit ripens in August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Monroe and Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Putnam (MacDougal); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyneke); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

MIMOSACEÆ. Mimosa Family.

ACUAN Adans.

A. ILLINOENSIS (Michx.) Kuntze.

(*Desmanthus brachylobus* Benth.)

This southern and western form is credited to Indiana in the 6th edition of Gray's Manual, page 149, but it is certainly not of general occurrence. Abundant herbarium specimens are in hand from Clark County, the collections of Baird and Taylor, and Dr. Barnes. I have seen specimens from no other region. In my opinion the form is of rare occurrence in the southern and south-western counties. If found it would probably be on alluvial banks or in prairies.

CÆSALPINACEÆ. Senna Family.**CERCIS L.****C. CANADENSIS L. Red-bud. Judas-tree.**

Abundant throughout the State, especially developed in point of numbers in limestone hill regions. Its maximum development as to size is in the southern counties in moist, rich soil. When present in numbers or of large size, it is indicative of rich soil. While growing well in clay soils, it finds its best situation in loam. Wood exceedingly hard and close grained.

Flowers in April and May. Scarcely less handsome in fruit in August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Franklin (Meyncke); Dearborn (Collins); Jay, Delaware, Randolph and Wayne (Phinney); Gibson and Posey (Schneck); Noble (Van Gorder); Clark (Baird and Taylor); Monroe and Vigo (Blatchley); Marion and Hamilton (Wilson); Steuben (Bradner).

CASSIA L.**C. NICITANS L. Sensitive Pea. Wild Sensitive-plant.**

Chiefly in the southern counties of the State, growing in dry, sterile places. Not abundant in any locality.

Flowers in August and September.

Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Jefferson (Barnes); Fayette (Hessler); Monroe (Blatchley); Round Lake (Deam); Floyd (Barnes).

C. CHAMÆCRISTA L. Partridge Pea. Large-flowered Sensitive Pea.

Dry sand or clay soils. Somewhat common in southern counties, but not extending farther north than Tippecanoe according to reports.

Flowering season July and August.

Tippecanoe (Cunningham); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Daviess (Clements); Jefferson (Barnes); Franklin (Meyncke); Clark (Baird and Taylor); Vigo (Blatchley); Floyd (Barnes); Hamilton and Marion (Wilson).

C. TORA L. Low Senna.

Found in Floyd County by Dr. Clapp, no data as to station. I have found no other citation for the State. The specific inclusion of Indiana in the range of this species both in Gray's Manual and Britton and Brown doubtless rests on this collection. If rediscovered it will probably be found along the banks of streams.

C. MARYLANDICA L. Wild or American Senna.

Quite common, especially in the southern counties in alluvial or moist, rich soils. It is also found on sand or gravel bars. The most widely known member of the genus within the State.

Flowering season from middle of June until September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (J. M. Coulter); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Dearborn (Collins); Gibson and Posey (Schneck); Monroe and Vigo (Blatchley); Noble (Van Gorder); Fayette (Hessler); Kosciusko (Coulter); Hamilton and Marion (Wilson); Steuben (Bradner).

C. OCCIDENTALIS L. Coffee Senna.

In waste places, usually in sandy soils in the central and southern part of the State. Especially abundant in the region of the Knobs.

Flowers in July and August.

GLEDITSIA L.**G. TRIACANTHOS L. Honey Locust. Thorn Tree.**

Generally distributed, but never constituting any large per cent. of the forest forms. It is indicative of rich soil. It reaches its greatest development in size in the State in the lower Wabash valley. Dr. Schneck reports the following measurements of a specimen from that region: "Circumference three feet from the ground, eighteen feet; height from roots to first branch, sixty-one feet; total height, one hundred twenty-nine feet." The wood is very heavy, hard, and durable in contact with the soil. It is largely used locally for posts, rails and wagon hubs. Its true value is, however, scarcely appreciated. Low, rich, bottom lands, more rarely on dry, sterile hills.

Flowers in May and June.

Jefferson (Barnes); Putnam (MacDougal); Monroe and Vigo (Blatchley); Gibson and Posey (Schneck); Clark (Baird and Taylor); Daviess (Clements); Dearborn (Collins); Franklin (Meyncke); Noble (Van Gorder); Tippecanoe and Kosciusko (Coulter); Decatur (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner); Cass and Fayette (Hessler).

G. AQUATICA Marsh. Water or Swamp Locust.

Found only in the cypress swamps in the southwestern counties of the State, and not abundant there. A small tree of no economic value.

Flowers in June and July.

Gibson and Posey (Schneck); Knox (Bidgway).

GYMNOCLADUS Lam.

G. DIOICA (L.) Koch. Coffee nut. Kentucky Coffee Tree.

(*G. Canadensis* Lam.)

Usually found in rich woods and bottoms. It is somewhat sparsely distributed in the northern counties of its range, becoming more common southward and attaining its greatest numbers in the rich bottom lands of the Ohio River.

Not used locally except for posts and rails, for which its durability in contact with the ground specially fits it. Its liability to check in drying prevents its general use in manufacture, although it is sometimes used in cabinet making. It is a large tree, ranging from 80 to 100 feet high, with a diameter of from eighteen inches to three feet.

Flowering season, May and June. A more interesting object when in fruit.

Tippecanoe (Cunningham); Steuben (Bradner); Laporte; Kosciusko (Coulter); Cass (Hessler); Putnam (MacDougal); Franklin (Meyncke); Jefferson (Barnes); Dearborn (Collins); Gibson and Posey (Schneck); Noble (Van Gorder); Clark (Baird and Taylor); Monroe and Vigo (Blatchley); Marion and Hamilton (Wilson).

PAPILIONACEÆ. Pea Family.

BAPTISIA Vent.

B. AUSTRALIS (L.) R. Br. Blue False-Indigo.

Reported only from the southern counties, where it grows on the banks of the Ohio River in rich soil. Jefferson (J. M. Coulter); Clark (Baird and Taylor).

B. ALBA (L.) R. Br.

Of rare occurrence in dry soil in southern counties. The only herbarium specimens are in the collection of Dr. Clapp, made in Floyd County in 1839. The station was in the "Knobs" near New Albany.

B. TINCTORIA (L.) R. Br. Wild Indigo.

Sparingly found in dry, drift soil in the northern counties. The species is an undoubted member of our flora, but is very erratic in its behavior. It appears one year in fair abundance, then may not be found again for several years.

Flowers from June through August.

Steuben (Bradner).

B. BRACTEATA Ell.

(*B. leucophoea* Nutt.)

In dry prairies in the northern part of the State; of exceptional occurrence.

Flowers in April and May.

Steuben (Bradner).

B. LEUCANTHA Torr. and Gray.

Found in moist prairies or on bottom lands somewhat abundantly in the southern part of the State, more sparingly in the northern.

The flowering season extends from June into September.

Tippecanoe (Cunningham); Gibson and Posey (Schneck); Franklin (Meyneke); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Cass (Hessler); Vigo (Blatchley).

CROTALARIA L.**C. SAGITTALIS L. Rattle-box.**

Occurring in sterile prairie soil. Reported as rare in Gibson and Posey counties by Dr. Schneck, this being its only reported station.

Flowers in July and August.

LUPINUS L.**L. PERENNIS L. Wild Lupine.**

Occurring in sandy soil in a few northern counties.

Cass (Hessler); St. Joseph (Rothert); Noble (Van Gorder); Lake (Hill).

The variety *occidentalis* S. Wats. occurs in Steuben County, according to Mr. Bradner.

ALLIANCE

N. *officinalis* Linn. - *officinalis* Linn.

Common in the mountains of the State. It is found in the mountains of the State, and is found in the mountains of the State.

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TRIFOLIUM L. Clover. Trefoil.**T. AGRARIUM L. Yellow or Hop-clover.**

This eastern form has obtained a footing in the eastern counties, being found along roadsides in dry, rather sandy soil.

Randolph (Phinney); Dearborn (Collins).

T. PROCUMBENS L. Low Hop-clover.

Found in sterile, sandy fields in a few counties, in considerable abundance.

Flowering season commences in May and continues through the summer.

Tippecanoe (Cunningham); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Dearborn (Collins); Decatur (Ballard); Steuben (Bradner); Crawford (Blatchley).

T. ARVENSE L. Rabbit-foot or Stone Clover.

Found in dry soil, usually preferring clay, chiefly in the western part of the State.

Blooms in July and August.

Dubois (Barnes); Marshall and Monroe (Blatchley); Clark (Baird and Taylor); Daviess (Clements); Noble (Van Gorder); Kosciusko (Chipman); Steuben (Bradner); Marshall (Hessler).

T. PRATENSE L.

Abundant everywhere, occurring in meadows and open woods. Much of its local distribution due to escape from cultivation. Reported practically from every county in the State.

T. REFLEXUM L. Buffalo Clover.

Rare in the southern counties, where it occurs in dry, sandy soil, either on hillsides or prairies.

Flowers in May.

Vigo (Blatchley); Gibson and Posey (Schneck); Franklin (Meyncke); Marion.

T. STOLONIFERUM Muhl. Running Buffalo Clover.

Admitted upon authority of State Catalogue (Editors Bot. Gaz.), on a citation from Marion County by the late Herbert E. Copeland. So far as I have been able to learn, this is the only report of the species within our bounds.

T. HYBRIDUM L. Alsike Clover.

Very much resembling *T. repens*, from which it is rarely distinguished. In certain parts of the State, notably in Kosciusko and adjoining counties, it is rapidly replacing the latter form. It is becoming quite common in the northern part of the State, less frequent in the central portions, and is entirely absent from the extreme southern counties.

Kosciusko (Chipman); Decatur (Ballard); Noble (Van Gorder); Hamilton (Wilson); Steuben (Bradner).

T. REPENS L. White Clover.

Common everywhere and growing under most diverse conditions. Its distribution in our area is probably entirely due to cultivation. In certain waste areas in the State, which have never been cultivated, it is entirely absent, although the conditions for its growth seem exceptionally favorable. Reported practically from every county in the State.

PSORALEA L.**P. STIPULATA T. and G.** Large-stipuled Psoralea.

Confined to limestone rocks in the extreme southern counties of the State. It occurs in Jefferson and Clark counties sparingly. No other stations are reported.

It flowers in the localities indicated in June.

P. PEDUNCULATA (Mill.) Vail.

(*P. melilotoides* Michx.)

This form has come into our flora from the south and is confined to the southern portion of the State. It grows in dry, usually sandy soil.

Flowering late in May or early in June.

Jefferson (Coulter); Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck).

P. ONOBRYCHIS Nutt.

More generally distributed than the other species of this genus, but not extending farther north than Tippecanoe and Cass counties. Found in moist or sandy soils, more abundant in the southern part of its range.

Flowers in May and June.

Tippecanoe (Cunningham); Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Clark (Baird and Taylor); Carroll; Daviess (Clements); Cass (Hessler).

AMORPHA L.

A. FRUTICOSA L. False or Bastard Indigo.

In wet soils, but more frequently along the banks of streams, whence the name "river locust" sometimes given the plant. Its reported stations are all in the southern half of the State. According to Dr. Schneck, the leaves when bruised exhale a strong, unpleasant odor.

Flowers in May and June.

Vigo and Parke (Blatchley); Gibson and Posey (Schneck); Franklin (Meyneke); Knox (Spillman).

A. NANA Nutt. Fragrant False Indigo.

(*A. microphylla* Pursh.)

A single station of what I take to be this species is found on the second terrace of Eagle Lake, Kosciusko County. The terrace is drift sand and is so steep as to scarcely furnish a foothold for grass. I have studied the plant closely for five seasons, and am convinced that it is *A. nana*. Not having compared the material with specimens from the normal range of the plant, it is admitted tentatively. The recorded range of the species is altogether west of the Mississippi River.

A. CANESCENS Pursh. Lead Plant. Shoestrings. Wild Tea.

Not especially abundant, but occurring in sandy or gravelly soils in several widely separated counties. It is usually found in dry situations, but at times works its way into low, wet lands immediately adjoining the ridges or banks which it frequents.

Flowers in June and July.

Tippecanoe (Cunningham); White (Hussey); Kosciusko and Marshall (Coulter); Cass (Hessler); Jasper (Barnes); Steuben (Bradner); Lake and Vigo (Blatchley).

KUHNIESTERA Lam.

K. CANDIDA (Willd.) Kuntze. Wild Prairie Clover.

(*Petalostemon candidus* Michx.)

In dry, sandy soil in the central and southern parts of the State. Nowhere abundant.

Flowering in June and July.

Cass (Hessler); Jasper (Barnes); White (Hussey); Tippecanoe (Coulter); Vigo (Blatchley).

K. PURPUREA (Vent.) MacM. Violet Prairie Clover.*(Petalostemon violaceus Michx.)*

More widely distributed and much more abundant than the preceding. Dry places and in prairies.

Flowers in June and July.

Tippecanoe (Cunningham); Daviess (Clements); Cass (Hessler); Vigo (Blatchley); St. Joseph and Jasper (Barnes); White (Hussey); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Kosciusko (Coulter).

CRACCA L.**C. VIRGINIANA L. Cat-gut. Goat's-rue.***(Tephrosia Virginiana Pers.)*

In sandy soils throughout the State, being more abundant in the northern parts. As a liana it is a prominent member of the basswood dunes along the southern shores of Lake Michigan. While more abundant in the north, it is of much larger size in the south and more frequently occurs as an erect shrub.

Flowering season, May and June.

Cass (Hessler); Knox and Vigo (Blatchley); Jefferson (Barnes); Clark (Baird and Taylor); Noble (Van Gorder); Lake, Porter, and Laporte; Steuben (Bradner).

KRAUHNIA Raf.**K. FRUTESCENS (L.) Greene. American Wistaria.***(Wistaria frutescens Poir.)*

In low, wet grounds, occurring sparingly at two widely separate localities, viz., Gibson and Posey counties (Schneck); Jay (Phinney); Kosciusko (Coulter).

It blooms in June, and in its northern range is a trailing shrub.

ROBINIA L.**R. PSEUDACACIA L. Black or Yellow Locust. False Acacia.**

Common throughout the State through planting and naturalization. It suffers greatly in certain seasons from the attacks of the locust borer (*Cyrtene picta*). The dense, hard wood is of great value and from an economic standpoint has few superiors. Locally it is principally used for posts and wagon hubs. There are records of posts of this species that have been set over fifty years and are yet sound. Its best development is along streams and in black, sandy loam. Its soil requirements seem about those

of the black walnut. In such localities it reaches a diameter of nearly two feet. It also occurs in dry, sandy or gravelly soil, but in much less perfect development. The early shedding of the leaves is a serious objection to its use in lawns or yards.

It flowers from early in May till in June, depending upon its location.

Daviess (Clements); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Franklin (Meyncke); Clark (Baird and Taylor); Noble (Van Gorder); Monroe and Vigo (Blatchley); Putnam (MacDougal); Decatur and Shelby (Ballard); Steuben (Bradner).

ASTRAGALUS L.

A. PLATTENSIS Nutt.

This species is credited to Indiana in the Manuals of Gray and Britton and Brown. So far as I am able to discover, the species has been reported from but one station, Lafayette Junction in Tippecanoe County. It was only once found in this station, but abundant herbarium material confirms its appearance at that time. It was probably brought in by the railroads, and maintained itself for a single season on the dry, gravelly hills characterizing its station. It is certainly not of general occurrence in the State.

A. CAROLINIANUS L. Carolina Milk-vetch.

(*A. Canadensis* L.)

Quite common along streams and lake margins in various counties of the State.

In July and August, when in full bloom, it is one of the most conspicuous plants in the regions in which it occurs.

Kosciusko (Coulter); Cass (Hessler); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Franklin (Meyncke); Clark (Baird and Taylor); Noble (Van Gorder).

STYLOSANTHES Sw.

S. BIFLORA (L.) B. S. P. Pencil-flower.

(*S. elatior* Swartz.)

Very rare in our bounds. Three stations are reported. From the "barrens" near Palmyra (Barnes) and from Gibson and Posey (Schneck). In all cases the form occurred in dry soil and was noted as rare.

Crawford (Blatchley).

MEIBOMIA Adans.

M. NUdiflORA (L.) Kuntze. Naked-flowered Tick Trefoil.*(Desmodium nudiflorum DC.)*

Widely distributed throughout the State, occurring in dry soils, usually in rocky, open woods or in thickets. I have found it in splendid development, however, in extremely wet lowlands.

It flowers in July and August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Clark (Baird and Taylor); Gibson and Posey (Schneck); Monroe and Vigo (Blatchley); Fayette (Hessler); Hamilton (Wilson); Round Lake (Deam); Steuben (Bradner).

M. GRANDIFLORA (Walt.) Kuntze. Pointed-leaved Tick Trefoil.*(Desmodium acuminatum DC.)*

Occurs over practically the same range as the preceding species. It is usually very common in woods and thickets, not being able to maintain itself in the open.

Flowers from June to August.

Reported counties the same as in the last form.

M. PAUCIFLORA (Nutt.) Kuntze. Few-flowered Tick Trefoil.*(Desmodium pauciflorum DC.)*

Confined to the southern half of the State, where it is sparingly found in moist woods and thickets. It is nowhere reported as common.

Flowers from June to August.

Daviess (Clements); Jefferson (J. M. Coulter); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Franklin (Meyncke); Clark (Baird and Taylor); Fayette (Hessler).

M. MICHAUXII Vail. Prostrate Tick Trefoil. Round-leaved Tick Trefoil.*(Desmodium rotundifolium DC.)*

In dry woods and thickets in various parts of the State.

Flowering season from latter part of July to September.

Kosciusko (Coulter); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Vigo (Blatchley); Franklin (Meyncke); Round Lake (Deam); Steuben (Bradner).

M. SESSILIFOLIA (Torr.) Kuntze. Sessile-Leaved Tick Trefoil.
(*Desmodium sessilifolium* Torr and Gray.)

Apparently absent from the central western counties, but frequent in other parts of the State. Its best development is in clay soils, although it is also found in dry, sandy locations.

Flowers from July to September.

Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Vigo (Blatchley); Lake; Steuben (Bradner).

M. CANESCENS (L.) Kuntze. Hoary Tick Trefoil.
(*Desmodium canescens* DC.)

In moist, rich soils, evidently preferring shade. Met with frequently at the borders of hedges and thickets. In Cass County according to Dr. Hessler it is found in wooded, sandy soil, an evidently exceptional situation.

Tippecanoe (Cunningham); Cass (Hessler); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Clark (Baird and Taylor); Vigo (Blatchley); Jefferson; Carroll, Hamilton, and Marion (Wilson); Steuben (Bradner).

M. BRACTEOSA (Michx.) Kuntze. Large-bracted Tick Trefoil.
(*Desmodium cuspidatum* Hook.)

In dry, clay soil or at the margin of thickets, occasionally in the open prairie. Not abundant in any of the stations where it occurs.

Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Vigo (Blatchley); Franklin (Meyncke); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Hamilton (Wilson); Steuben (Bradner).

M. PANICULATA (L.) Kuntze. Panicked Tick Trefoil.
(*Desmodium paniculatum* DC.)

Occurs in thickets and low grounds, having its greater abundance in the southern portion of the State.

Flowers from July to September.

Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Franklin (Meyncke); Clark (Baird and Taylor); Daviess (Clements); Monroe (Blatchley); Fayette (Hessler); Noble (Van Gorder); Steuben (Bradner).

M. LÆVIGATA (Nutt.) Kuntze.*(Desmodium lævigatum DC.)*

In dry woods in the southern part of the State.

Flowers in August and September.

I have specimens from Clark County, but find no other record for the State.

M. VIRIDIFLORA (L.) Kuntze. Velvet-leaved Tick Trefoil.*(Desmodium viridiflorum Beck.)*

Confined to the southern counties, where it is found in dry soils.

Flowers in August in our range.

Putnam (MacDougal); Jefferson (J. M. Coulter); Gibson (Schneck).

M. DILLENII (Darl.) Kuntze.*(Desmodium Dilleni Darl.)*

Dry, open woods and prairies.

Flowering from July to September.

Monroe and Vigo (Blatchley); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Noble (Van Gorder); Round Lake (Deam); Hamilton and Marion (Wilson).

M. CANADENSIS (L.) Kuntze. Showy Tick Trefoil.*(Desmodium Canadense DC.)*

Not uncommon in moist thickets and woods in various parts of the State.

Flowers in July and August.

Tippecanoe (Cunningham); Daviess (Clements); Monroe and Vigo (Blatchley); Jasper (Barnes); Putnam (MacDougal); Jefferson (J. M. Coulter); Noble (Van Gorder); Franklin (Meyncke); Clark (Baird and Taylor); Laporte.

M. GLABELLA (Michx.) Kuntze.*(Desmodium humifusum Beck.)*

Sandy soil, frequent. Found upon sides of canal near Five-Mile Pond and on roadside near Heckland, Vigo County.

Collected June 15.

So far as I know, this is the only record for the State. The data given are those of Mr. Blatchley.

M. RIGIDA (Ell.) Kuntze. Rigid Tick Trefoil.*(Desmodium rigidum DC.)*

Rather common in dry, open woods.

Flowers July to September.

Floyd (Clapp); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Noble (Van Gorder); Clark (Baird and Taylor).

M. MARYLANDICA (L.) Kuntze. Smooth Small-leaved Tick Trefoil.*(Desmodium Marilandicum Boott.)*

Of infrequent occurrence in the southern counties of the State.

Found in open, hilly woods or in damp thickets and woodlands.

Flowers in July.

Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Vigo (Blatchley).

M. OBTUSA (Muhl.) Vail. Hairy Small-leaved Tick Trefoil.*(Desmodium ciliare DC.)*

In sandy soil or upon dry hills. Never abundant.

Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Monroe.

LESPEDEZA Michx.**L. REPENS (L.) Bart. Creeping Bush-clover.**

In the southern counties of the State in dry or sandy soils. Very abundant in the Knobs region.

Flowers in August and September.

Jefferson, Gibson, Floyd, and Harrison.

L. PROCUMBENS Michx. Trailing Bush clover.

Not found in the northern counties, fairly distributed in the central and southern. Usually growing in dry soils, preferably those containing much sand.

Floyd (Barnes); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck).

In the region of the Knobs in Floyd County it has been collected in bloom on May 25; its usual flowering season is, however, July and August.

L. VIOLACEA (L.) Pers. Bush-clover.

More widely distributed and more abundant than preceding species. It is found frequently on dry, clay banks, and on hill-sides and in thickets; occasionally in its northern range in sandy soil.

The flowering season is from July to August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Cass (Hessler); Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Gibson and Posey (Schneck); Noble (Van Gorder); Clark (Baird and Taylor); Steuben (Bradner).

L. FRUTESCENS (L.) Britton. Wand-like Bush-clover.

(*L. reticulata* S. Wats., not Pers.)

Of fair distribution in dry, open soil, in our range preferring sand soils.

Flowers July to September.

Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Vigo (Blatchley); Tippecanoe (Cunningham); Round Lake (Deam).

L. VIRGINICA (L.) Britton. Slender Bush-clover.

(*L. violacea angustifolia* T. and G.)

Probably not separated in all references from preceding species. In much the same soils and with the same flowering season.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Round Lake (Deam); Lake (Hill); Gibson.

L. HIRTA (L.) Ell. Hairy Bush-clover.

(*L. polystachya* Michx.)

Common in the localities in which it is found. Frequent in dry soil containing much clay and dry, rocky woods.

Flowers July to September.

Monroe (Blatchley); Washington (Barnes); Gibson and Posey (Schneck); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Lake; Steuben (Bradner).

L. CAPITATA Michx. Round-headed Bush-clover.

Frequent in dry, sandy soil in various counties.

Flowers in July and August.

Floyd (Clapp); Vigo (Blatchley); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Tippecanoe (Cunningham); Lake; Cass (Hessler); Steuben (Bradner).

L. ANGUSTIFOLIA (Pursh) Ell. **Narrow-leaved Bush-clover.**

First collected by Mr. W. S. Blatchley, growing in dry prairies in Vigo County and reported as rare. Collected in 1896 in Tippecanoe County by Miss Cunningham. Reported also from Cass by Dr. Hessler, with following note: "A single large, bushy plant was found along the railroad, east of Lake Cicott; perhaps a migrant."

Flowers in August in our range.

VICIA L.

V. CRACCA L. **Tufted or Cow Vetch.**

Throughout the State, growing in dry soil. Not nearly so abundant as succeeding species.

Flowers in June and July.

Steuben (Bradner); Tippecanoe (Coulter).

V. AMERICANA Muhl. **American Vetch. Pea-vine.**

Restricted to moist lowlands in the northern part of the State.

Flowers from June to August.

Kosciusko (Coulter); Noble (Van Gorder).

V. CAROLINIANA Walt. **Carolina Vetch.**

River banks and along the margins of lakes. Occasionally found on wet cliffs.

Flowers in June and July.

Cass (Hessler); Franklin (Meyncke); St. Joseph (Rothert); Washington (Barnes); Clark (Baird and Taylor); Tippecanoe (Coulter); Steuben (Bradner).

LATHYRUS L.

L. MARITIMUS (L.) Bigel. **Beach Pea. Seaside Pea.**

This form is naturally confined to the shores of Lake Michigan, where its significance as a character plant of certain beach stretches and in dune building has been indicated by Dr. Cowles. It occurs in Lake and Porter counties. Added to the flora by Rev. E. J Hill.

L. VENOSUS Mubl. **Veiny Pea.**

The only record for the State that I am able to find is from Noble County, where the form was collected by Superintendent Van Gorder, from whom abundant herbarium material was secured. Britton and Brown mention Indiana specifically in giving the range of the plant. I scarcely believe it to be of general occurrence.

L. PALUSTRIS L. Marsh Vetchling.

Common in counties from which it is reported, except those in the southwestern part of the State. Found along streams and ditches or in wet soils.

Begins flowering in May and continues through the summer.

Tippecanoe (Hussey); Vigo (Blatchley); Gibson and Posey (Schneck); Johnson (Hubbard); Dearborn (Collins); Carroll; Hamilton (Wilson); Steuben (Bradner).

L. MYRTIFOLIUS Muhl. Myrtle-leaved Marsh Pea.

(*L. palustris myrtifolius* Gray.)

Moist soils in a few widely separate counties of the State. Commences to flower in May and continues through the summer.

Noble (Van Gorder); Vigo (Blatchley); Knox (Spillman); Lake.

L. OCHROLEUCUS Hook. Cream-colored Vetching.

Reported only from Noble County by Mr. W. B. Van Gorder.

The herbarium material collected in June showed plants in full bloom and pods beginning to form.

Steuben (Bradner).

FALCATA Gmel.**F. COMOSA (L.) Kuntze. Wild or Hog Pea-nut.**

(*Amphicarpæa monoica* Ell.)

Common and widely distributed in the State. Occurs in moist, rich soils in shaded places.

Flowers from July until September.

Tippecanoe (Cunningham); Gibson and Posey (Schneck); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Putnam (MacDougal); Franklin (Meyncke); Monroe and Vigo (Blatchley); Fayette (Hessler); Kosciusko (Coulter); Steuben (Bradner).

F. PITCHERI (T. and G.) Kuntze.

(*Amphicarpæa Pitcheri* Torr. and Gray.)

Very similar to the preceding, with which it perhaps intergrades. First reported by Mr. W. S. Blatchley from Vigo County, the station being "Coal Creek, in damp, rich soil in hillside thickets; scarce." Later reported as very common in Hamilton County by Mr. Guy W. Wilson.

APIOS Moench.

A. APIOS (L.) MacM. Ground-nut.

(A. tuberosa Moench.)

Low, wet grounds in many counties, preferring rich soils.

Flowers from July to September.

Monroe and Vigo (Blatchley); Kosciusko (Coulter); Putnam (MacDougal); Tippecanoe (Cunningham); Gibson and Posey (Schneck); Clark (Baird and Taylor); Dearborn (Collins); Franklin (Meyneke); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Fayette (Hessler); Hamilton (Wilson); Steuben (Bradner).

The reports show the form to be more abundant in the northern part of its range, and especially so in the marshy thickets surrounding small lakes. In almost all of the southern counties it is relatively rare.

GALACTIA P. Br.

G. REGULARIS (L.) B. S. P. Milk Pea.

(G. glabella Michx.)

Reported only by Dr. A. J. Phinney as occurring in the region embracing Jay, Delaware, Randolph, and Wayne counties. It is found in dry, rather sandy soils, flowering in July. I was able last season to secure specimens of this form from Wayne County.

G. VOLUBILIS (L.) Britton. Downy Milk Pea.

(G. pilosa Ell.)

Reported only from two counties, so far as I am able to discover. In both instances it occurred in dry, sandy or gravelly soil. It flowers with us in July.

Putnam (MacDougal); Kosciusko (Coulter).

PHASEOLUS L.

P. POLYSTACHYUS (L.) B. S. P. Wild Bean. Bean Vine.

(P. perennis Walt.)

Common in localities in which it is found. Its most common habitat is in woods and thickets, seemingly having a wide soil range, but requiring shade.

Flowers in July and August.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Dearborn (Collins); Gibson and Posey (Schneck); Noble (Van Gorder); Clark (Baird and Taylor); Monroe (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

STROPHOSTYLES ELL.

S. HELVOLA (L.) Britton. Trailing Wild Bean.*(S. angulosa Ell.)*

Apparently confined to the central and southern counties. It is found in dry soils, in open places. The soils it prefers seem to be those with heavy admixtures of sand or clay.

Flowers in August and September.

Jefferson (Barnes); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Gibson and Posey (Schneck); Franklin (Meyncke); Hamilton (Wilson).

S. UMBELLATUS (Muhl.) Britton. Pink Wild Bean.*(S. peduncularis Ell.)*

Confined to the southern counties of the State, growing in open or light shades, in dry, sand or clay soils.

Flowers from July to September.

Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Vigo (Blatchley); Clark (Baird and Taylor).

S. PAUCIFLORA (Benth.) S. Wats. Small Wild Bean.*(S. pauciflorus Watson.)*

Occurring only in Gibson and Posey counties, where it is found along the banks of streams. Dr. Schneck reports it as rare.

Flowers late in July and in August.

GERANIACEÆ. Geranium Family.

GERANIUM L.

G. MACULATUM L. Crane's Bill. Wild Geranium. Alum Root.

Common throughout the State in open woods and thickets. Being somewhat brought into cultivation, but not proving satisfactory on account of its very straggling growth.

Flowers from April to July.

Jefferson (Barnes); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Kosciusko (Coulter); Daviess (Clements); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); St. Joseph (Rothert); Decatur and Shelby (Ballard); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

G. CAROLINIANUM L. Carolina Crane's Bill.

Found abundantly in many parts of the State, but not reported as occurring north of Tippecanoe County. It grows in dry, gravelly, rather sterile soil in open places.

Flowers from April through August.

Monroe and Vigo (Blatchley); Cass and Fayette (Hessler); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Daviess (Clements); Tippecanoe (Cunningham); Knox (Spillman); Marion (Wilson).

ERODIUM L'Her.**E. CICTARIUM (L.) L'Her. Stork's Bill. Heron's Bill.**

Found only in the southwestern counties in waste places. Rather local, but abundant in its stations.

Flowers from April until September.

Gibson and Posey (Schneck).

OXALIDACEÆ. Wood-sorrel Family.**OXALIS L.****O. VIOLACEA L. Violet Wood-sorrel.**

Found abundantly throughout the State in moist soils in woods or open places. A well-known form.

Flowers from April until in June.

Jefferson (Barnes); Putnam (MacDougal); Vigo and Monroe (Blatchley); Fayette (Hessler); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Clark (Baird and Taylor); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Knox (Spillman).

O. STRICTA L. Yellow Wood-sorrel. Sheep-sorrel.

(*O. corniculata stricta* Sav.)

Abundantly distributed throughout the State, in some localities becoming a troublesome weed. It is found in various situations, but is most plentiful and of stronger habit in moist, rich soils. The species varies largely both as to size and pubescence.

Flowers from April through September.

Jefferson (Barnes); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Dearborn (Collins); Daviess (Clements); Tippecanoe (Ives); Kosciusko (Coulter); Monroe and Vigo (Blatchley); Fayette (Hess-

ler); Decatur (Ballard); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

LINACEÆ. Flax Family.

LINUM L.

L. USITATISSIMUM L. Flax. Linseed.

In many counties of the State along roads and railways and also as an escape from cultivation. It maintains itself well and spreads rapidly in most parts of the State.

Flowers in June and July.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Clark (Baird and Taylor).

L. VIRGINIANUM L. Wild Yellow Flax.

Chiefly found in the southern counties of the State in shaded places. It is found in rather dry, sandy or clayey soil, and is nowhere abundant.

Flowers from June through August.

Monroe and Vigo (Blatchley); Gibson and Posey (Schneck); Tippecanoe (Hussey); Franklin (Meyncke); Clark (Baird and Taylor).

L. STRIATUM Walt. Ridged Yellow Flax.

In the southern part of the State in wet soils. I have not seen the plant, but the species is admitted upon the authority of Dr. John M. Coulter.

Flowering specimens collected June 19.

Jefferson (J. M. Coulter).

L. SULCATUM Riddell. Grooved Yellow Flax.

Found only in the northern part of the State in dry, sandy soil.

Flowering specimens were collected on July 28.

Jasper (Barnes); Lake (Hill).

RUTACEÆ. Rue Family.

XANTHOXYLUM L.

X. AMERICANUM Mill. Prickly Ash. Toothache Root.

A small tree, sometimes	a shrub, wh ^l
distributed over the St	7 reaches
twenty feet and a dia	six to ei

rapidly disappearing from the southwestern part of the State. The light and coarse-grained wood is valueless, but the bark is somewhat largely used medicinally. Rocky hillsides, more often along streams and rich river bottoms.

Flowers in April and May.

Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Jefferson (J. M. Coulter); Dearborn (Collins); Cass (Hessler); Hamilton (Doane); Kosciusko (Coulter); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

PTELEA L.

P. TRIFOLIATA L. Hop tree. Shrubby Trefoil.

Commonly distributed throughout the State, usually in shady localities. Frequent on shady, rocky hillsides. A small tree, ranging from twelve to fifteen feet in height and with a diameter of from six to nine inches. In many parts of the State the species occurs as a shrub. The foliage leaves have an unpleasant odor when bruised; the bitter fruit is sometimes used as a substitute for hops.

Flowers in May and June.

Jefferson (Barnes); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke); Hamilton (Doane); Cass and Fayette (Hessler).

SIMARUBACEÆ. Ailanthus Family.

AILANTHUS Desf.

A. GLANDULOSA Desf. Tree of Heaven.

Escaped from cultivation very largely in some of the southern counties. I have seen whole hillsides completely covered with this species. It spreads especially in a coarse, rocky soil. The foliage has a fetid, disagreeable odor when bruised, and the staminate flowers are especially ill-scented.

Flowers in June and July.

Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Marion (Wilson); Fayette (Hessler).

POLYGALACEÆ. Milkwort Family.

POLYGALA L.

P. CRUCIATA L. Marsh Milkwort.

Found in the northern counties only, growing in moist, sandy soils.

Flowers from July until in September.

Cass (Hessler); Lake (Hill); Steuben (Bradner).

P. VERTICILLATA L. Whorled Milkwort.

Found in dry prairies or upland woods in several counties, but in none of its stations abundant.

Flowers from July until October.

Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Vigo (Blatchley); Steuben (Bradner); Tippecanoe and Crawford.

P. AMBIGUA Nutt. Loose-spiked Milkwort.

(*P. verticillata ambigua* Wood.)

Found only in the southwestern counties in dry, sand soils, usually in exposed places.

Flowers in July and August.

Gibson and Posey (Schneck).

P. VIRIDESCENS L.

(*P. sanguinea* L.)

This is, in our area, the most frequent and widely distributed species of the genus. It is found in various situations, growing either in moist, alluvial soils or in sandy soil. It seems more plentiful as a rule in sandy or gravelly soils.

Flowers from early in June until September.

Tippecanoe (Cunningham); Cass (Hessler); Jefferson (J. M. Coulter); White (Hussey); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Noble (Van Gorder); Gibson and Posey (Schneck); Vermillion (Wright); Steuben (Bradner).

P. NUTTALLII T. and G.

Found in southern part of the State in dry, sandy soil in open places. In one locality quite abundant along a roadside for a distance of a mile or more.

Flowering from July until September.

Jefferson (J. M. Coulter).

P. SENEGA L. Seneca Snake root.

Found in very many counties of the State in rocky soils, usually in shaded localities. It is as widely distributed and almost as abundant as *P. viridescens*.

Flowers in May, continuing until September.

Jefferson (Young); Monroe (Hessler); Putnam (MacDougal); Vigo (Blatchley); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Clark (Barnes); Kosciusko (Coulter); Daviess (Clements); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Noble (Van Gorder); St. Joseph (Rothert); Cass (Hessler); Steuben (Bradner).

P. SENEGA LATIFOLIA T. and G.

Associated with the former, but less widely distributed. Not easily separated from the type species.

Wayne (Plummer); Clark (Baird and Taylor); Franklin (Meyncke); Jefferson (Barnes); Vermillion (Wright); Vigo (Blatchley).

P. POLYGAMA Walt. Racemed Milkwort.

Occurring in dry, sandy soil in a few counties of the State. It is an easily recognized form, and the citation is confirmed by numerous herbarium specimens.

Flowers from June until in August.

Vigo (Blatchley); Elkhart (Barnes); Lake and St. Joseph.

EUPHORBIACEÆ. Spurge Family.**PHYLLANTHUS L.****P. CAROLINENSIS Walt.**

Found sparingly in the southern part of the State growing on sandy or gravelly banks along roadsides.

Flowers from May until the heavy frosts.

Jefferson (Barnes); Gibson and Posey (Schneck); Vigo (Blatchley).

CROTON L.**C. GLANDULOSUS L.**

Specimens sent me by Mr. H. J. Clements, of Washington, Indiana, are to be referred to this species. The form grows in sandy soil in open places.

Flowering specimens were collected in April.

Daviess (Clements).

C. CAPITATUS Michx. Hogwort.

In the southern counties of the State in dry soils, but nowhere abundant.

Flowers from May until October.

Clark (Baird and Taylor); Floyd and Harrison.

C. MONANTHOGYNUS Michx.

This species is also confined to the southern part of the State and is of exceptional occurrence, though reported from several counties.

Flowers from June until in September.

Putnam (MacDougal); Clark (Baird and Taylor); Johnson (Barnes); Fayette (Hessler);

ACALYPHA L.**A. VIRGINICA L. Three-seeded Mercury.**

Common in various counties in thickets and woods, preferring sandy soils. More common in the southern counties.

Flowers from June through September.

Tippecanoe (Cunningham); Jefferson (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Franklin (Meyncke); Clark (Baird and Taylor); Daviess (Clements); Putnam (MacDougal); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

A. GRACILENS Gray.

(*A. Virginia gracilens* Muell.)

In low or sandy waste places, usually in shaded localities. Not so abundant as the preceding, from which it is not always distinguished.

Flowers from June through September.

Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Hamilton (Wilson); Vigo (Blatchley).

EUPHORBIA.

E. POLYGONIFOLIA L. Sea-side or Knot-weed Spurge.

In sand soils about the southern shores of Lake Michigan. Not found far inland. One of our most characteristic littoral plants.

Flowers from July until September.

Lake (Hill); Porter (Cowles).

E. MACULATA L. Spotted Spurge.

Common throughout the State in dry soils. Frequent on sandy banks and along roadsides.

Flowers from June until the heaviest frosts.

Putnam (MacDougal); Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Gibson and Posey (Schneck); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

E. HUMISTRATA Engelm. Hairy Spreading Spurge.

Common in old fields and on banks in dry soils. Probably throughout the State.

Flowers from July until October.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Vigo (Blatchley).

E. NUTANS Lag. Large or Upright Spotted Spurge.

(*E. Prestii* Guss.)

Very widely distributed and abundant, perhaps our most common form. Usually in dry soils in fairly shaded situations.

Flowers from May until in October.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Gibson and Posey (Schneck); Clark (Baird and Taylor); Vermillion (Wright); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

E. COROLLATA L. Flowering Spurge.

In all parts of the State and very abundant. An attractive form used largely in decorations. It grows in dry situations at the edges of fields, along roads or upon railway embankments. It acts as a skin irritant in many cases.

Flowers from April until in October.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (J. M. Coulter); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Gibson and Posey (Schneck); Clark (Baird and Taylor); Vermillion (Wright); Cedar Lake (Deam); Fayette (Hessler); Vigo (Blatchley); Hamilton (Wilson); Steuben (Bradner).

E. MARGINATA Pursh. White-margined Spurge. Showy Euphorbia.

Introduced into the southern part of the State and largely escaped from cultivation. In some regions the form has covered large areas, especially rapid in its spread on the rocky slopes of limestone hills. It has also invaded cultivated fields, especially those with a coarse, rocky soil, and has become an annoying weed.

Flowers from May until the late frosts.

Jefferson (Barnes); Franklin (Meyncke); Gibson and Posey (Schneck); Hamilton (Wilson).

E. DENTATA Michx. Toothed Spurge.

Abundant in many parts of the State. It is found most plentifully at the base of limestone cliffs and in rich, sandy soils. In either situation it is found in shaded locations.

Flowers from July until October.

Cass and Fayette (Hessler); Putnam (MacDougal); Vigo (Blatchley); Franklin (Meyncke); Clark (Baird and Taylor); Marion and Montgomery.

E. IPECACUANHÆ L. Wild Ipecac.

In the southern part of the State in dry, sandy soil. Especially frequent in the region of the Knobs. Locally used as an emetic.

Flowers from May until October.

Marion, Floyd, Scott, and Harrison.

E. HETEROPHYLLA L. Various-leaved Spurge.

This species has entered our flora from the west and is sparingly found in a few western counties, growing on sandbanks or barren hillsides.

Flowers from April until the heaviest frosts.

Vigo (Blatchley); Tippecanoe (Golden).

E. OBTUSATA Pursh.

This species has entered the flora from the south. It is reported only from Gibson, though probably occurring in adjoining counties. Found in dry soil.

Flowers from March until August.

E. COMMUTATA Engelm. Tinted Spurge.

Quite abundant on shaded hillsides and along streams in rich, sand loams.

Flowers from March until August.

Tippecanoe (Cunningham); Jefferson and Clark (Barnes); Monroe and Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyneke); Fayette (Hessler); St. Joseph (Rothert).

E. ESULA L. Leafy Spurge.

From the southwestern part of the State largely, so far as reports show. In waste places in sandy soil.

Flowers from May until October.

Gibson and Posey (Schneck); Steuben (Bradner).

E. CYPARISSIAS L. Cypress Spurge.

Escaped from gardens in a few counties and growing well on dry banks.

Tippecanoe (Cunningham); Noble (Van Gorder); Laporte (Barnes); St. Joseph (Rothert); Vigo (Blatchley); Hamilton and Marion (Wilson).

CALLITRICHACEÆ. Water Starwort Family.**CALLITRICHE L.****C. AUSTINI Engelm. Terrestrial Water Starwort.**

Reported from but one county. In damp shaded places.

Flowers from July to September.

Gibson.

C. HETEROPHYLLA Pursh. Larger Water Starwort.

In ponds and slow streams.

Flowers from July to September.

Gibson.

LIMNANTHACEÆ. False Mermaid Family.**FLERKEA Willd.****F. PROSERPINACOIDES Willd. False Mermaid.**

Found chiefly in southern counties in rich, wet soils, usually along streams. It is, however, nowhere abundant.

It flowers with us late in April or early in May, depending upon its location.

Monroe and Vigo (Blatchley); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Marion; Hamilton (Wilson); Porter (Hill); Tippecanoe.

ANACARDIACEÆ. Sumac Family.

RHUS L.

R. COPALLINA L. Dwarf or Black Sumac.

In dry soil, chiefly on hills and ridges. Most frequent in the southern part of the State. The form is not poisonous, but should be handled with care by persons with sensitive skins. "The leaves and bark contain much tannin, and are collected in large quantities in the southern states and ground for tanning leather." (Britton and Brown.)

Flowers in June and July.

Kosciusko (Coulter); White (Hussey); Franklin (Meyncke); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Monroe (Blatchley); Steuben (Bradner).

R. HYPERICIFOLIA (L.) Sudw. Staghorn Sumac.

(*R. typhina* L.)

In various parts of the State on hillsides or in sandy or gravelly soil. While frequent, it is not especially abundant in any of its stations. The bark is rich in tannin.

Flowers in June and July.

Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Kosciusko (Chipman); Lake; Steuben (Bradner).

R. GLABRA L. Scarlet Sumac.

Common in all parts of the State in sandy or gravelly soil, occupying waste places often to the exclusion of all other shrubs. The foliage sometimes used in tanning. Not poisonous, but in some cases known to have caused serious eruptions of the skin.

Flowers from June through August.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Putnam (MacDougal); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Gibson and Posey (Schneck); Clark (Baird and Taylor); Monroe and Vigo (Blatchley); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

R. AROMATICA Ait. Sweet-scented Sumac.*(R. Canadensis Marsh.)*

Widely distributed and quite abundant in most parts of the State. It is found in thin, sandy soil or on limestone ledges and also in rocky woods.

Flowers in March and April.

Tippecanoe (Cunningham); Monroe and Crawford (Blatchley); Cass (Hessler); Jefferson (Barnes); Dearborn (Collins); Franklin (Meyncke); Clark (Baird and Taylor); Lake.

R. VERNIX L. Poison Elder. Poison Sumac.*(R. venenata DC.)*

This very poisonous form is very largely, if not entirely, confined to the swamp regions of the northern part of the State. It is as a rule quite abundant in the stations in which it occurs. Its favorite location seems to be in tamarack swamps.

Flowers in June and July.

Kosciusko (Coulter); Cass and Marshall (Hessler); Noble (Van Gorder); Hamilton (Wilson); Steuben (Bradner); Lake.

R. RADICANS L. Poison, Climbing or Three-leaved Ivy. Poison Oak.*(R. Toxicodendron L.)*

In all parts of the State in various situations, and of various habits. It is found as a bush from three to six feet high or as a vine climbing to the height of one hundred fifty feet or more. It usually is found in coarse, rocky or gravelly soils. Very poisonous to the touch. Its berries are not poisonous, and are largely eaten by birds.

Flowers from May until in July.

Kosciusko (Coulter); Elkhart (Barnes); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Monroe and Vigo (Blatchley); Putnam (MacDougal); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

ILICACEÆ. Holly Family.**ILEX L.****I. OPACA Ait. American Holly.**

In moist woods in sparing quantities in the southwestern counties. I have seen no Indiana specimens of the form, but it is admitted upon the authority of Mr. Robert Ridgway, whose monograph of the "Forest Flora of the Lower Wabash Valley" is one of the most valuable contributions to our knowledge of that portion of the State.

I. DECIDUA Walt. Swamp or Meadow Holly.

Very abundant in the southwestern part of the State, often forming extensive thickets around some of the ponds and sloughs in the cypress swamp.

Flowers unfold with the leaves in May.

Gibson and Monroe; Knox (Ridgway).

I. VERTICILLATA (L.) A. Gray. Winter Berry. Fever Bush.

In marshes or low wet grounds throughout the State. Usually abundant in the stations in which it occurs.

Flowers in June and July.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Cass (Hessler); Hamilton (Wilson); Steuben (Bradner); Gibson.

ILICIOIDES Dumont.**I. MUCRONATA (L.) Britton.**

(*Nemopanthes fascicularis.*)

In low, wet grounds and marshes, especially in the northern counties of the State. Most abundant in tamarack swamps.

Flowers in May and June.

Fulton (Hessler); Lake (Hill); Steuben (Bradner); Noble (Van Gorder); Putnam (MacDougal).

CELASTRACEÆ. Staff-tree Family.**EUONYMUS L.****E. AMERICANUS L. Strawberry Bush. Burning Bush.**

In low woods and along river banks, in rich or alluvial soil. Of somewhat limited distribution, and nowhere especially abundant.

Flowers in April and May.

Tippecanoe (Hussey); Jefferson (Barnes); Monroe (Dudley); Gibson and Posey (Schneck); Noble (Van Gorder).

E. OBOVATUS Nutt. Running Strawberry Bush.

(*E. Americanus obovatus* T. and G.)

Frequent in low, damp woods and thickets, and along rocky ledges. Widely distributed through the State.

Flowers from April through June.

Noble (Van Gorder); Franklin (Meyncke); Clark (Baird and Taylor); Putnam (MacDougal); Monroe and Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); St. Joseph (Rothert); Hamilton and Marion (Wilson); Steuben (Bradner); Cass and Fayette (Hessler).

E. ATROPURPUREUS Jacq. Burning Bush. Wahoo.

A handsome shrub or small tree, growing in rich alluvial soils, of wide distribution through the State. Largely cultivated as an ornamental shrub.

Flowers in May and June.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Gibson and Posey (Schneck); Dearborn (Collins); Jefferson (Barnes); Putnam (MacDougal); Monroe and Vigo (Blatchley); Noble (Van Gorder); Franklin (Meyneke); Jay, Delaware, Randolph, and Wayne (Phinney); Hamilton and Marion (Wilson); Steuben (Bradner); Cass and Fayette (Hessler).

CELASTRUS L.**C. SCANDENS L. Shrubby or Climbing Bittersweet. Staff-tree.**

A trailing or climbing woody vine found in all parts of the State, growing in rich soils, at the borders of woods and thickets. Especially handsome in autumn when the orange-yellow capsule bursts, exposing the showy red aril.

Flowering from May until August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Clark (Barnes); Jefferson (J. M. Coulter); Posey and Gibson (Schneck); Vigo and Monroe (Blatchley); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyneke); Dearborn (Collins); Daviess (Clements); Round Lake (Deam); Hamilton and Marion (Wilson); Steuben (Bradner); Cass and Fayette (Hessler).

STAPHYLEACEÆ.**STAPHYLEA L.****S. TRIFOLIA L. American Bladder-nut.**

A handsome, upright shrub usually growing in damp thickets or along streams. It is also found in many places in southern Indiana as a shrub of damp limestone cliffs, in which situation its habit is much modified.

It flowers in April and May, its drooping cluster of white flowers at the tips of the branches suggesting it as a suitable form for ornamentation.

Jefferson (Barnes); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Kosciusko (Coulter); Hendricks (Truckess); Decatur (Ballard); Knox (Spillman); St. Joseph (Rothert); Hamilton and Marion (Wilson); Steuben (Bradner); Fayette (Hessler).

ACERACEÆ. Maple Family.**ACER L.****A. SACCHARINUM L. Silver Maple. Soft or White Maple.***(A. dasycarpum Ehrh.)*

Well distributed throughout the State along streams. A large tree ranging from eighty to one hundred twenty feet high and reaching a trunk diameter of from three to five feet. The wood is hard, but somewhat brittle, being of less value than that of the Sugar Maple. It is quite largely used in the manufacture of furniture. The species is largely used for shade trees in streets and parks.

Flowers from February until April in its various situations.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Kosciusko (Coulter); Knox (Spillman); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson).

A. RUBRUM L. Red Maple. Water or Swamp Maple.

A well-known form, common in low, wet soils throughout the State. The species reaches a size equalling that of the preceding form. The wood is hard but not strong. It is largely used in furniture making, for woodenware, gun-stocks, etc. The most brilliant of the maples in autumnal coloration.

Flowers in March and April.

A few reported stations are the following: Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Decatur (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

A. SACCHARUM Marsh. Sugar Maple. Sugar Tree.*(A. saccharinum Wang.)*

Abundant over almost the entire State, reaching its highest development in rich upland soils. The tree is of great economic importance, an imperfect understanding of which has led to large waste. The tree occurs in fair abundance in all but two counties of the State. Apart from its value for sugar and syrup, the wood is of such varied use that the demand for it is leading to the destruction of many sugar orchards. It is largely used in the manufacture of furniture, shoe-lasts and pegs, saddle-trees, in turnery,

for interior finish and flooring; it is also largely employed in ship-building. "Curled Maple" and "Bird's-eye Maple" of cabinet-makers are varieties.

Flowers in February, March and April.

Its distribution is so general that specific reference to stations is omitted.

A. NIGRUM Michx. Black Sugar Maple.

(*A. saccharinum nigrum* T. and G.)

Sparingly distributed throughout the State along streams, and in low, rich lands in central and southern Indiana. Usually in lower ground than the preceding, and more closely confined to bottom lands. The wood is similar to that of the Sugar Maple, the sap also yielding much sugar.

Flowers in April and May.

Kosciusko (Coulter): Monroe and Vigo (Blatchley); Putnam (MacDougal): Hamilton and Marion (Wilson); Gibson and Posey (Ridgway).

A. NEGUNDO L. Box Elder. Ash leaved Maple.

(*Negundo aceroides* Moench.)

Fairly distributed through the southern counties of the State on wet banks, becoming more rare northward, except in the prairie regions where it has been largely planted for a windbreak. The light wood is of no great value, although somewhat used in interior finish and for paper pulp. Locally largely used for sap troughs. Cultivated as an ornamental tree in all parts of the State.

Flowers as early as April and as late as July.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Kosciusko (Coulter); Daviess (Clements); Cass (Hessler); Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

HIPPOCASTANACEÆ. Buckeye Family.

ÆSCULUS L.

Æ. HIPPOCASTANUM L. Horse Chestnut.

A handsome tree cultivated for ornament which in a few cases seems to have escaped from cultivation. I know of three instances in which these escapes have successfully held their own for over ten years. While not common save under cultivation, the species has undoubtedly obtained a foothold in the State.

Æ. GLABRA Willd. Ohio Buckeye. Fetid Buckeye.

Commonly distributed throughout the State, in low, rich soil, except in the region of the lower Wabash, where it is reported as rare. It is a sign of rich soil, and has its mass distribution along streams in the bottom lands. Not used locally except for fuel, although a valuable timber in certain manufactures, notably that of artificial limbs, for which it is preferred to any other wood. It is also used somewhat largely in the manufacture of paper pulp.

Flowers in April and May. The poisonous effect of its fruit upon cattle is, perhaps, considerably exaggerated. The tree has a prospective value which makes desirable a conservation of the remaining forms.

Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Jefferson (Barnes); Tippecanoe (Cunningham); Kosciusko (Coulter); Hendricks (Trucksess); Decatur and Shelby (Ballard); Jay, Delaware, Randolph, and Wayne (Phinney); Clinton and Boone (Coulter); Hamilton and Marion (Wilson); Steuben (Bradner).

Æ. OCTANDRA Marsh. Yellow or Sweet Buckeye.

(*Æ. flava* Ait.)

Of very limited distribution. Reported only from Jefferson and a few adjoining counties, and in these localities as occurring in sparing numbers. Found in rich woods and along streams.

Flowers in April and May.

Wood of the same general character as the preceding, and adapted to the same uses.

SAPINDACEÆ. Soapberry Family.**CARDIOSPERMUM L.****C. HALICACABUM L. Balloon Vine.**

In waste places. Common in cultivation and occasionally escaping from gardens.

Flowers during summer.

BALSAMINACEÆ.

IMPATIENS L.

I. AUREA Muhl. Pale Touch-me-not.

(I pallida Nutt.)

Characteristic of rich, moist soils in shaded localities.

The flowering season is short so far as the individual plant is concerned, but the form may be found in bloom in various localities through June, July, and August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyneke); Monroe (Blatchley); Putnam (MacDougal); Jefferson (Barnes); Shriner Lake (Deam); Decatur and Shelby (Ballard); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner); Fayette (Hessler).

I. BIFLORA Walt. Spotted Touch-me-not.

(I. fulva Nutt.)

Found in similar localities, but less frequent than the former. Both forms of the genus are probably found in every part of the State in greater or less abundance.

In addition to the localities cited for *I. aurea*, there are to be added: Knox (Spillman); Vermillion (Wright); Steuben (Bradner).

In addition to the distinction afforded by the flowers, the form may usually be separated from *aurea* by its smaller size and lighter green leaves.

RHAMNACEÆ. Buckthorn Family.

RHAMNUS L.

R. LANCEOLATA Pursh. Lance-leaved Buckthorn.

Sparingly distributed in the State, growing in moist soils and especially abundant on limestone outcrops.

Flowers in May and June.

Tippecanoe (Cunningham); Clark (Barnes); Cass (Hessler).

R. CAROLINIANA Walt. Carolina Buckthorn.

Discovered in the southern counties by Mr. W. S. Blatchley, growing on rocky hillsides. Abundant in the stations in which it occurs. The species entered the Indiana flora from the south.

Flowering season, May and June.

Crawford and Harrison (Blatchley).

CEANOTHUS L.

C. AMERICANUS L. New Jersey Tea.

Found abundantly in sandy soils, usually in open or light shaded places. Where it obtains a foothold it frequently spreads over wide areas to the practical exclusion of other shrubs. Common name derived from the fact that an infusion of the leaves was used as tea by the American troops during the Revolution.

Flowers from May until in August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Cass (Hessler); Laporte (Barnes); White (Hussey); Vermillion (Wright); Daviess (Clements); Gibson and Posey (Schneck); Vigo (Blatchley); Steuben (Bradner).

C. OVATUS Desf. Smaller Red-root.

Found only in dry sand or gravel beaches, or open stretches, in the northern part of the State. It is probably of more general distribution than the citations indicate, being in many instances confused with the preceding species which it resembles.

Flowers from May until July.

Lake (Hill).

VITACEÆ. Grape Family.

VITIS L.

V. LABRUSCA L. Fox Grape. Plum Grape.

In thickets, usually in rather moist soils in several parts of the State. Its range is probably wider than the citations indicate, the difficulty of satisfactorily discriminating the various species of the genus leading to their scant collection. "The cultivated Isabella, Concord and Catawba grapes have been derived from this species" (Britton and Brown).

Flowers in May; fruit ripens in August and September.

Putnam (MacDougal); Gibson and Posey (Schneck); Cass (Hessler); Hamilton and Marion (Wilson); Jefferson.

V. AESTIVALIS Michx. Summer Grape. Small Grape.

Common throughout the State in thickets, frequenting rather dry soils. It is one of our most characteristic lianas. The fruit is acid but edible, and is somewhat largely used.

Flowers in April and May; fruit ripens in September and October.

Monroe and Vigo (Blatchley); Gibson and Posey (Schneck); Kosciusko (Coulter); Putnam (MacDougal); Steuben (Bradner).

V. VULPINA L. Sweet-scented Grape. Riverside Grape.*(V. riparia Michx.)*

In many counties of the State, rather strictly confined to banks of streams in rocky soils. More abundant in the southern counties.

Flowers in April and May; fruit ripens from July, continuing until in October.

Gibson and Posey (Schneck); Putnam (MacDougal); Vigo (Blatchley); Tippecanoe (Coulter); Hamilton and Marion (Wilson).

V. CORDIFOLIA Michx. Frost Grape. Chicken Grape.

Common throughout the State in moist thickets and along the banks of streams. It thrives best in rich bottom lands.

Flowers in April and May; fruit ripens after the heavier frosts.

Jefferson (J. M. Coulter); Putnam (MacDougal); Monroe and Vigo (Blatchley); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Daviess (Clements); Hamilton and Marion (Wilson); Steuben (Bradner).

V. RUPESTRIS Scheele. Sand Grape. Sugar Grape.

This southern form was first detected in sand soils in Lake County by Mr. Blatchley. Dr. Cowles had also collected the form, doubtfully referring it to *V. cordifolia*. Specimens were sent to Professor L. H. Bailey, of Cornell University, who referred the form as above. It occurs abundantly in various stations in the region indicated.

Flowering from April to June; fruit ripe in August.

Lake (Blatchley).

AMPELOPSIS Michx.**A. CORDATA Michx.***(Cissus Ampelopsis Pers.)*

In the central and southern counties of the State in swamps and moist woods and thickets. Not common, but abundant in stations in which it occurs.

Flowers in May and June.

Putnam (MacDougal); Gibson and Posey (Schneck); Jefferson.

PARTHENOCISSUS Planch.

P. QUINTIFOLIA (L.) Planch. Virginia Creeper. Wild Ivy.

(*Ampelopsis quinquefolia* Michx.)

Common in rich woods and fields in all parts of the State. Usually climbing, rarely trailing in our area. Locally it is known often as "five-leaved Ivy" and "Woodvine." Somewhat cultivated.

Flowers from April through June. The species is also very handsome in the autumn because of the deep red leaf coloration and the numerous panicles of blue-black fruit.

Kosciusko (Conner); Monroe and Vigo (Blattley); Putnam (MacDougal); Gibson and Posey (Schreck); Jefferson (Barnes); Clark (Baird and Taylor); Hamilton and Marion (Wilson); Steuben (Bradner).

TILIACEÆ. Linden Family.

TILIA L.

T. AMERICANA L. Bass-wood. White-wood. Lin.

This tree, indicative always of rich soil, is fairly well distributed throughout the State, reaching its greatest development in the valley of the lower Wabash. A specimen from this region gave the following measurements: Circumference three feet from the ground, 17½ feet; height of trunk from roots to first branch, 50 feet; total height, 109 feet. The wood, while not strong, is very compact, close-grained and easily worked, and is used very largely in the manufacture of woodenware and other products not requiring great strength. It is also largely used in the manufacture of paper pulp. In some sections of the State it is used almost exclusively for making charcoal. In most instances, however, this valuable tree is only used for fuel.

Flowers in May and June; its fragrant flowers, rich in nectar, attracting countless bees and butterflies and other insects. Definite reports of its occurrence in fair abundance and of marketable size have been received from thirty-five counties, covering all parts of the State. So general is its distribution that it is unnecessary to give specific citations.

T. HETEROPHYLLA Vent. White Bass-wood. Bee-tree.

Very sparingly found in a few southern counties, growing in similar localities and associated with the preceding. Its wood is scarcely distinguishable from that of *T. Americana*, and is used for the same purposes.

Jefferson (J. M. Coulter); Gibson (Schneck); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney).

The Gibson County citation is of a single tree near the mouth of White River. In Jefferson and Clark a number of the trees may be found at the reported stations.

Flowers in June and July.

MALVACEÆ. Mallow Family.

MALVA L.

M. SYLVESTRIS L. High Mallow.

In the southern part of the State, about dwellings and along roadsides. Escaped from cultivation and well established.

Flowers from June until October.

Monroe (Blatchley); Fayette (Hessler); Gibson and Posey (Schneck); Decatur and Shelby (Ballard); Clark; Steuben (Bradner).

M. ROTUNDIFOLIA L. Common Mallow. Cheeses.

Common everywhere, but annoying only in lawns. Most frequent about dwellings and along roadsides.

Flowering season from May until November.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Clark (Baird and Taylor); Dearborn (Collins); Vermillion (Wright); Putnam (MacDougal); Hendricks (Trucksess); Decatur and Shelby (Ballard); Monroe (Blatchley); Wabash (Jenkins); St. Joseph (Rothert); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

M. VERTICILLATA CRISPA L. Whorled Mallow.

(*M. crispa* L.)

Escaped from cultivation and established in central part of the State. Not abundant nor widely distributed.

Flowering specimens collected in June.

Putnam (Underwood).

M. MOSCHATA L. Musk Mallow.

In waste, rather sandy soils, in a few central and northern counties. Odor of musk quite distinct on warm, moist days.

Flowers in June and July.

Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Steuben (Bradner).

NAPÆA L.

N. DIOICA L. Glade Mallow.

In rich, moist soils, rather plentiful in its stations.
Flowering and fruiting specimens collected in August.
Tippecanoe (Cunningham); Carroll.

MALVASTRUM A. Gray.

M. ANGUSTUM Gray. Yellow False Mallow.

Along railways in the eastern counties of the State. Not common. Probably a migrant.
Flowering in July and August.
Jay, Delaware, Randolph, and Wayne (Phinney).

SIDA L.

S. SPINOSA L. Prickly Mallow. Thistle Mallow.

Abundant in fields and waste grounds, especially in the southern part of the State. Most frequent in sandy soil in open places.
Flowers from April until October.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyneke); Clark (Baird and Taylor); Vermillion (Wright); Shelby (Ballard); Union (MacDougal); Hamilton and Marion (Wilson).

ABUTILON Gaertn.

A. ABUTILON (L.) Rusby. Velvet Leaf. Butter Print. Indian Mallow.*(A. Avicennæ Gaertn.)*

Found abundantly in all parts of the State in waste grounds, often invading cultivated fields. It is regarded as a bad weed, because difficult of eradication. Prefers dry, rather sandy or coarse soils.

Flowers from July until the middle of October.

Tippecanoe (Cunningham); Kosciusko (Coulter); Jefferson (J. M. Coulter); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyneke); Clark (Baird and Taylor); Fayette (Hessler); Wabash (Jenkins); Decatur (Ballard); Monroe and Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

HIBISCUS L.

H. MOSCHEUTOS L. Swamp Mallow.

Exceptionally found in marsh regions, but abundant in none of its stations.

Flowers in August and September.

Kosciusko (Chipman); Clark (Baird and Taylor); Knox (Spillman); Lake (Hill).

H. LASIOCARPUS Cav. Rose Mallow.

Common in wet prairies and the borders of prairie swamps in the southern counties, becoming rarer northward, and not reported as occurring north of Hamilton County.

Flowers from July until September.

Vigo (Blatchley); Daviess (Clements); Gibson and Posey (Schneck); Hamilton (Wilson).

H. MILITARIS Cav. Halberd-leaved Rose Mallow.

Found on banks of streams and in overflowed, sandy bottom lands. Quite plentiful in its stations, but not occurring in the northern part of the State.

Flowers from June through August.

Vigo, Daviess and Parke (Blatchley); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Knox (Ridgway).

H. TRIONUM L. Bladder Mallow.

In waste places in various counties of the State, probably escaped from cultivation.

Flowers from May through September.

Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Hamilton and Marion (Wilson); Steuben (Bradner); Monroe (Hessler).

HYPERICACEÆ. St. John's-wort Family.

ASCYRUM L.

A. HYPERICOIDES L. St. Andrew's Cross.

(*A. Cruz-Andree* L.)

In dry, sandy soil in a few southern counties. Nowhere abundant.

Flowers from July through September.

Clark (Baird and Taylor); Jefferson (J. M. Coulter); Monroe and Crawford (Blatchley).

HYPERICUM L.

H. ASCYRON L. Great St. John's-wort.

In a few counties along streams and in wet places. Probably of wider range than citations indicate.

Flowers in July and August.

Monroe and Putnam (Blatchley); Noble (Van Gorder).

H. KALMIANUM L.

In the northern part of the State in wet sandy or gravelly soils bordering swamps. Nowhere abundant, but not infrequent.

Flowering in August and September.

Lake (Hill); Laporte (Barnes); Wabash (Jenkins).

H. PROLIFICUM L. Shrubby St. John's-wort.

On the banks of streams and in moist, open places in many counties of the State. Quite abundant in its stations.

Flowers from June through August.

Monroe and Vigo (Blatchley); Gibson and Posey (Schneck); Kosciusko (Coulter); Cass (Hessler); Jefferson (J. M. Coulter); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyneke); Steuben (Bradner).

H. DENSIFLORUM Pursh. Bushy St. John's-wort.

Exceptionally found in a few counties, at the edges of woods in dry, sterile soils.

Flowers from August until October.

Tippecanoe (Cunningham); Vigo (Blatchley).

H. ADPRESSUM Bart. Creeping St. John's-wort.

Occasional in the southwestern counties in moist, low grounds.

Flowers in July and August.

Gibson and Posey (Schneck).

H. SPHAEROCARPUM Michx.

On wet limestone cliffs, or in wet, coarse soils in a few stations. Quite plentiful in the localities in which it occurs.

Flowers from July through September.

Putnam (MacDougal); Clark (Baird and Taylor); Cass (Hessler); Carroll.

H. PERFORATUM L. Common St. John's-wort.

Found abundantly throughout the State in old fields and meadows, and along roadsides. In some localities a troublesome weed. Crushed plant odorous.

Flowers from June until September.

St. Joseph (Barnes); Putnam (MacDougal); Jay, Delaware. Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyneke); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Steuben (Bradner).

H. MACULATUM Walt. Spotted or Corymbed St. John's-wort.
(*H. Corymbosum* Muhl.)

In moist soil.

Flowers from July to September.

Steuben (Bradner).

H. MUTILUM L. Dwarf St. John's-wort.

Common throughout the State in low, usually moist grounds.

Flowers from June until September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyneke); Monroe and Vigo (Blatchley); Fayette (Hessler); Hamilton (Wilson).

H. MAJUS (Gray) Britton.

(*H. Canadense majus* Gray.)

In central and northern part of the State in low, wet grounds, especially abundant near lakes and marshes.

Flowers from June through September.

Laporte (Barnes); Putnam (MacDougal); Lake (Hill).

H. CANADENSE L.

In situations similar to the preceding, but in rather more sandy soil.

Flowers from July through September.

Pulaski (Noel); Clark (Baird and Taylor); Noble (Van Gorder); Putnam (MacDougal); Steuben (Bradner).

H. DRUMMONDII (Gray and Hook.) T. and G.

Occasionally found in dry, hard soil in the southwestern counties of the State. Only reported by Dr. J. Schneck.

Flowering specimens collected in August.

Gibson and Posey (Schneck).

H. ELLIPTICUM Hook.

In Hamilton and Marion counties growing in wet places (G. W. Wilson).

SAROTHTA L.**S. GENTIANOIDES L. Pine-weed.**

(*Hypericum nudicaule* Walt.)

Reported only from the extreme southwestern counties of the State as occurring occasionally in sterile, sandy soil.

Flowering from June through September.

Gibson and Posey (Schneck); Lake (Hill).

TRIADENUM Raf.**T. VIRGINICUM L. Marsh St. John's-wort.**

(*Elodes campanulata* Pursh.)

Plentifully found in swamps and marshes in most parts of the State, being more abundant in the northern counties.

Flowers from July through September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Laporte (Barnes); Noble (Van Gorder); Gibson and Posey (Schneck); Steuben (Bradner).

T. PETIOLATUM (Walt.) Britton.

(*Elodes petiolata* Pursh.)

Admitted upon a collection of Dr. Robert Hessler in Monroe County. Plant was collected in July in low, wet grounds. The only record for the State to my knowledge.

ELATINACEÆ. Water-wort Family.**ELATINE L.****E. AMERICANA (Pursh) Arn. Water-wort.**

Reported only from Gibson and Posey counties by Dr. Schneck. It occurs there in moist or marsh places in considerable abundance.

Flowering in May and June.

Steuben (Bradner).

CISTACEÆ. Rock-rose Family.

HELIANTHEMUM.

H. CANADENSE (L.) Michx. Frost-weed.

Occurring more abundantly in the northern part of the State, though extending into the southern counties. The flowering season extends from June in the southern counties, through August in the northern. Late in the fall, crystals of ice shoot out from the cracked bark near the root, a fact explaining the popular name.

Kosciusko (Coulter); Vigo (Blatchley); Cass (Hessler); Elkhart (Barnes); Noble (Van Gorder); St. Joseph (Rothert); Clark (Baird and Taylor).

HUDSONIA L.

H. TOMENTOSA Nutt.

A sand-loving plant confined to the shores of Lake Michigan and rarely extending far inland. Reported from Lake County by E. J. Hill, and as a member of the dune floras of Lake and Porter counties by Dr. H. C. Cowles.

LECHEA Pinweed.

L. MINOR L.

(*L. thymifolia* Michx.)

An insignificant perennial growing in dry, sterile ground.

Lake (Hill); Cass (Hessler); Vigo (Blatchley); Steuben (Bradner).

It seems to be more abundant in the northern counties.

L. VILLOSA Ell.

(*L. major* Michx.)

Another form found in dry, sterile situations, with its more abundant local distribution in the southern portion of the State.

Lake (Hill); St. Joseph (Rothert); Cass (Hessler); Kosciusko (Coulter); Clark (Baird and Taylor); Dubois (Barnes); Steuben (Bradner).

L. MARITIMA Leggett. Beach Pin-weed.

(*L. minor maritima* Gray.)

In sandy pine-barrens. This has been reported from Lake County by Rev. E. J. Hill.

VIOLACEÆ. Violet Family.

VIOLA L.

V. PALMATA L. Blue Violet.

Found abundantly in most parts of the State, growing in dry, shaded places, but not infrequently in open meadows.

Flowering begins in April and May, and continues through the summer.

Jefferson (Barnes); Tippecanoe (Hussey); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Franklin (Meyncke); Clark (Baird and Taylor); Putnam (MacDougal); Daviess (Clement); Decatur and Shelby (Ballard); Kosciusko (Coulter); Hamilton and Marion (Wilson).

V. PEDATIFIDA Don.

In a few localities in the State in dry, open places, in sandy soil. Nowhere abundant.

Flowers from March until May.

Wayne (Phinney); Gibson and Posey (Schneck); Vigo (Blatchley).

V. OBLIQUA Hill. Common Blue Violet.

(*V. palmata cucullata*.)

In all parts of the State in moist, low grounds. The ordinary blue violet of the State. Occasional white flowers are found.

Flowering begins in March and continues through the summer.

Jefferson and Madison (Barnes); Tippecanoe (Hussey); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Gibson and Posey (Schneck); Kosciusko (Coulter); Daviess (Clement); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Dearborn (Collins); Decatur (Ballard); St. Joseph (Rothert); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

V. SAGITTATA Ait. Arrow-leaved Violet.

In the southern counties at the borders of moist prairies and exceptionally in dry, open woods. Not common in any of its stations.

Flowering in April and May.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Knox (Spillman); Steuben (Bradner); Lake.

V. PEDATA L. Bird's-foot Violet.

In rather dry, rich soils in woods or upon shaded slopes, in the northern counties of the State. Quite plentiful in many of its stations.

Flowering in May and June.

Kosciusko (Coulter); Cass (Hessler); Tippecanoe (Hussey); Dearborn (Collins); Noble (Van Gorder); Wayne (Phinney); St. Joseph (Rothert); Steuben (Bradner); Lake.

V. ROTUNDIFOLIA Michx. Round-leaved Violet.

In the southern counties, growing on rocky, limestone hillsides. Exceptionally found.

Flowering in April and May.

Dearborn (Collins); Jefferson (Young).

V. BLANDA Willd. Sweet White Violet.

In damp soils on shaded hillsides or low grounds, in many parts of the State. Not abundant in any of its stations.

Flowering in April and May.

Floyd (Clapp); Monroe and Vigo (Blatchley); Tippecanoe (Cunningham); Clark (Baird and Taylor); Noble (Van Gorder); Putnam (MacDougal); Decatur (Ballard); Jefferson (Barnes); Steuben (Bradner); Lake.

V. PRIMULÆFOLIA L.

Reported from the extreme southwestern counties, as occurring "rarely" in moist soils. I have seen no specimens. Admitted on authority of Dr. J. Schneck.

Flowering in April.

Gibson and Posey (Schneck).

V. LANCEOLATA L. Lance-leaved Violet.

Growing at the margins of ponds and in damp, open places in many counties. The flowers are very slightly fragrant.

Flowering from April until June.

Vigo (Blatchley); Tippecanoe (Cunningham); Elkhart and Jefferson (Barnes); Clark (Baird and Taylor); Dearborn (Collins).

V. HASTATA Michx. Halberd-leaved Yellow Violet.

This species is reported from the hill regions of southern Indiana. It probably exceptionally occurs in a few stations.

Flowers in April and May.

Clark (Baird and Taylor).

V. *Amphispiza bilineata* - Hairy Towhee.

This species is common in the State in the winter months and is abundant in the spring. It is found in the same localities as the other species of the genus.

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V. *Amphispiza bilineata* and *S. *serripennis - Striped Towhee.**

Amphispiza bilineata and *S. *serripennis**

This species is common in the State in the winter months and is abundant in the spring. It is found in the same localities as the other species of the genus.

V. *Amphispiza bilineata*

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V. *Amphispiza bilineata* - Pine or Striped Towhee.

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V. *Amphispiza bilineata* - American Ing Towhee.

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V. ROSTRATA Pursh. Long-spurred Violet.

Reported from four counties. The southern station is the "Clifty Ravine," in Jefferson County, a locality noted for the number of exceptional forms it contains. Not abundant in either of its stations.

Flowering in June and July.

Jefferson (Barnes); Noble (Van Gorder); Steuben (Bradner); Laporte.

V. TRICOLOR L. Pansy.

Found in waste places in some of the southern counties as an escape from cultivation. As an escape it rapidly loses in size and number of flowers, and also in variety of colors. After a few years, it blooms but sparingly and the flowers are very small.

Flowering season from April until June.

Knox (Spillman); Shelby (Ballard); Jefferson.

V. TENELLA Muhl. Field Pansy.

Not uncommon in the southern counties in woods and fields, growing in rich soils and with almost as great frequency on sandy banks.

Flowers from March until August.

Jefferson and Madison (Barnes); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Dearborn (Collins); Vigo (Blatchley); Tippecanoe.

CUBELIUM Raf.**C. CONCOLOR (Forst.) Raf. Green Violet.**

(*Solea concolor* Ging.)

In moist, shaded places, usually in rocky or coarse soil. Also found in alluvial soils. Plentiful in the stations in which it occurs.

Flowering season from May until July.

Jefferson (Barnes); Tippecanoe (Hussey); Monroe and Vigo (Blatchley); Putnam (MacDougal); Cass and Fayette (Hessler); Clark (Baird and Taylor); Franklin (Meyncke); Wayne (Phinney); Hamilton (Wilson).

PASSIFLORACEÆ. Passion Flower Family.**PASSIFLORA L.****P. LUTEA L. Yellow Passion Flower.**

Found only in a few localities in the southern counties. Mr. Blatchley reports it from four stations in Monroe County, and Dr. Hessler as rare in Fayette County. I have found it on a single hillside in Jefferson County, trailing over limestone rocks. In Monroe County it is found on hillsides and in thickets. In our area it is a lime soil plant.

It blooms somewhat sparingly during June, July and the earlier part of August, and is one of the most delicate and graceful members of our flora.

Gibson.

CACTACEÆ. Cactus Family.**OPUNTIA Mill.****O. HUMIFUSA Raf. Western Prickly Pear.**

(*O. Rafinesquii* Engelm.)

This is the only member of the Cactus family within our bounds. It is found in great abundance in the northwestern corner of the State in dry sand. In July and August its large yellow flowers (two to four inches broad), and prostrate, deep green stem, make it a marked feature. The Pennsylvania Railway is skirted for miles with this unique form. In 1885 it was found at Lafayette Junction, in Tippecanoe County, by Dr. Barnes, but failed to maintain itself. It was also reported from near Attica, Warren County, but a visit to the locality showed that if it had been present it had not maintained itself beyond a single season. It seems to be spreading somewhat along the line of several railways entering Chicago, but will probably not extend permanently beyond the sand covered region.

THYMELEACEÆ.**DIRCA L.****D. PALUSTRIS L. Leather-wood. Moose-wood.**

A well known shrub, flowering in April and May. While found in many parts of the State it is nowhere abundant, and is in some places rapidly disappearing. The cause of its failure to maintain itself has not yet been made out. The plant is poisonous, the poison being very abundant in the bark. Applied to the skin, the

bark produces blisters and ulceration; taken internally violent vomiting results.

Tippecanoe (Cunningham); Cass and Fayette (Hessler); Putnam (MacDougal); Hamilton (Wilson); Decatur (Ballard); Steuben (Bradner).

ELAEAGNACEÆ. Oleaster Family.

LEPARGYRÆA Raf.

L. CANADENSIS (L.) Greene. Canadian Buffalo-berry. (*Shepherdia Canadensis* Nutt.)

This northern shrub has found its only station in Indiana in Lake County, from which it was reported by E. J. Hill. In our region it is in flower in May, the fruit becoming ripe in August. It is easily recognized by the dense, silvery stellate hairs upon the under surface of the leaf.

LYTHRACEÆ. Loosestrife Family.

AMMANNIA L.

A. COCCINEA Rottb. Long-leaved Ammania.

A swamp plant confined to the southern counties of the State. It flowers from July to September.

Vigo and Monroe (Blatchley); Gibson and Posey (Schneck).

ROOTALA L.

R. RAMOSIOR (L.) Koehne.

Found only in swamps or very wet lands in southern part of the State. Flowers July to September.

Jefferson (J. F. Baird); Vigo (Blatchley); Clark.

DECODON Gmel.

D. VERTICILLATUS (L.) Ell. Swamp Loosestrife.

Of fairly general distribution, being much more abundant in the northern part of the State. Found in swamps or pools of back-water from lakes or streams.

Flowers July to September.

Kosciusko (Coulter); Vigo and Monroe (Blatchley); Cass (Hessler); Gibson and Posey (Schneck); Noble (Van Gorder); Marshall (Blatchley); Round Lake (Deam); Hamilton (Wilson); Steuben (Bradner); Laporte.

LYTHRUM L.

L. ALATUM Pursh. Loosestrife.

Characteristic of low grounds, and usually very abundant when found at all. In the rich low grounds about the margin of smaller lakes, or on the banks of ditches it is often a dominant form.

Flowering season begins in June and continues through August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Cass (Hessler); White (Hussey); Franklin (Meyncke); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Vermillion (Wright); Lake (Hill); Hamilton (Wilson); Steuben (Bradner).

PARSONSIA P. Br.

P. PETIOLATA (L.) Rusby. Tar-weed. Clammy Cuphea.

(*Cuphea viscosissima* Jacq.)

Found in dry soil in various parts of the State, but nowhere abundant. In our area it flowers most abundantly in June, although the flowering season continues until September. One of the favorite locations is upon railroad embankments.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Monroe (Blatchley); Fayette (Hessler).

MELASTOMACEÆ. Meadow Beauty Family.

RHEXIA L.

R. VIRGINICA L. Meadow-beauty. Deergrass.

In sandy, wet soil in various parts of the State.

Its flowering period is July and August. Its bright purple flowers make it a conspicuous object in the rather barren localities in which it is usually found.

Reported from Kosciusko (Coulter); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Marshall (Hessler).

ONAGRACEÆ. Evening Primrose Family.

ISNARDIA L.

I. PALUSTRIS L. Water Purslane.

(*Ludwigia palustris* Ell.)

Of frequent occurrence throughout the State, being found in ditches and stagnant pools.

It flowers early in July and continues in bloom until September.

Jefferson (J. M. Coulter); Vigo and Monroe (Blatchley); Franklin (Meyneke); Clark (Baird and Taylor); Jay, Delaware, Wayne, and Randolph (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Fayette (Hessler); Marion and Hamilton (Wilson); Steuben (Bradner).

LUDWIGIA. False Loosestrife.

L. POLYCARPA Short and Peter.

Of sparing occurrence in wet, rich soil.

Reported stations are: Jay, Delaware, Randolph, and Wayne (Phinney); Gibson (Schneck); Steuben (Bradner).

L. ALTERNIFOLIA L.

A common and very variable form, especially abundant in the low lands about inland lakes.

When in flower in July and August it is frequently the most notable form in such localities.

Herbarium specimens from Jefferson (J. M. Coulter); Monroe (Blatchley); Franklin (Meyneke); Clark (Baird and Taylor); Kosciusko (Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Steuben (Bradner).

JUSSIEA L.

J. DECURRENS (Walt.) DC.

This southern marsh form has a single reported station. The plant was collected by Dr. A. Clapp, of New Albany, in 1839, and is verified by specimens in the Clapp herbarium. From its mass distribution its most natural appearance in our bounds would be in Gibson and Posey counties instead of Floyd. The record of the occurrence of the species in Indiana in the past is unmistakable. It is doubtful, however, whether it occurs as a present member of our flora. Quite a number of forms found in the Clapp collections seem to have disappeared from our flora, a fact which emphasizes the importance of continued studies of definite areas, in order to determine in some measure plant movements now in progress.

CHAMENERION.

C. ANGUSTIFOLIUM (L) Scop. Great Willow Herb. Fire-weed. Fire-pink.*(Epilobium angustifolium L.)*

This striking form is so far as reported confined to low grounds in the northern parts of the State. It is apt to occur where tracts have been burnt over, or in fresh clearings. Its appearance in burnt areas has given it the name of fire-weed. It is cultivated somewhat largely in parks, especially where "mass effects" are desired.

Fulton (Hessler); Noble (Van Gorder); Tippecanoe (Hussey); Laporte (Barnes); Steuben (Bradner).

The Tippecanoe County reference is verified by abundant herbarium material. It has however not been reported in the past twelve years, although several complete studies have been made of the flora of the county during that period.

EPILOBIUM L.

E. LINEARE Muhl.*(E. palustre lineare Gray.)*

A low ground form, usually in marshes, occurring sparingly in various counties.

Tippecanoe (Hussey); Noble (Van Gorder); Jefferson (Coulter); Gibson (Schneck); Monroe; Laporte; Lake (Hill); Hamilton and Marion (Wilson).

E. STRICTUM Muhl.

Reported from Noble County by W. B. Van Gorder and Dr. Barnes. The citation is verified by herbarium specimens.

Steuben (Bradner); Floyd (Clapp).

E. COLORATUM Muhl.

Of general distribution and quite abundant in low, marshy soils.

Tippecanoe (Cunningham); Kosciusko (Coulter); Laporte (Barnes); Putnam (MacDougal); Vigo (Blatchley); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Franklin (Meyneke); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Marion (Blatchley); Fayette (Hessler); Steuben (Bradner).

The species commences to bloom in July, and in favoring situations continues in flower until October.

E. ADENOCAULON Haussk.

A plant collected by Mr. W. W. Chipman in Kosciusko County is without question to be referred to this species. This is, however, the only recorded station for the State. It is probably not uncommon in wet places in our northern counties, having escaped detection because of the difficult discrimination of the species of this genus.

ONAGRA Adans.**O. BIENNIS (L.) Scop. Common Evening Primrose.**
(*Enothera biennis* L.)

Abundant throughout the State and very variable. Its favorite locality seems to be in dry soil regions with fair exposure to the sun. It also occurs in fair development in moist regions with but slight apparent adaptations. In wet soils the flowering season seems slightly shorter, and the foliage leaves more deeply green.

The species begins to flower in June and continues through September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Monroe (Blatchley); Putnam (MacDougal); Clark (Baird and Taylor); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Dearborn (Collins); Noble (Van Gorder); Fayette (Hessler); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

GENOTHERA L. Evening Primrose.**GE. LACINIATA Hill.**(*GE. sinuata* L.)

A variable form chiefly decumbent in our area. It is reported from Vigo (Blatchley); Daviess (Clements); Fayette, a railroad migrant (Hessler).

GE. RHOMBIPETALA Nutt.

This form is reported from various counties, chiefly southern. In all the localities found it is reported as "scarce" or rare. While its mass distribution is southern, it is found as far north as Lake.

Flowers June and July.

Hamilton (Wilson); Lake.

ANOGRA Spach.

A. ALBICAULIS (Pursh) Britton. Prairie Evening Primrose.*(Enothera albicaulis Nutt.)*

An exceptional form of occasional occurrence in the southern counties. Its northern limit in the State seems to be in Hamilton County (Wilson), where it occurs along the L. E. & W. Railway.

KNEIFFIA.

K. PUMILA (L.) Spach.*(Enothera pumila L.)*

In dry situations in the northern part of the State.

Herbarium specimens from Laporte (Barnes), and Noble (Van Gorder).

K. FRUTICOSA (L.) Raimann. Sundrops.*(Enothera fruticosa L.)*

As a rule found only in low, rich soils, although occasionally found in dry localities. The species is very variable, and is frequently incorrectly referred.

It flowers most profusely in May and June, although occasional flowers may be seen late in August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jasper (Barnes); Monroe (Blatchley); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Cass (Hessler).

LAVAUXIA Spach.

L. TRILOBA WATSONII Britton. Three-lobed Primrose.*(Enothera triloba parviflora S. Wats.)*

This western form is reported from Monroe County by W. S. Blatchley, as "frequent along streams and in gravelly soil."

The flowers were collected in July.

It is possible that this reference should be to *L. triloba* (Nutt.) Spach., a form naturally in our territory in such soils, and withal extremely variable.

GAURA L.

G. COCCINEA Pursh. Scarlet Gaura.

In dry soil, flowering in July and August. Reported only from Fayette County by Robert Hessler. The form is so decidedly western in its range that its occurrence in a single locality in the State must be looked upon as due to some exceptional means of distribution. (A railroad migrant. R. H.)

G. BIENNIS L.

A common form, usually found in dry soil, but in certain parts of its range in the State very abundant in low, wet lands, associated with Fringed Loosestrife (*Steironema ciliatum*).

Flowers from July to September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Jasper (Barnes); Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Franklin (Meynecke); Vermillion (Wright); Hamilton and Marion (Wilson); Fayette (Hessler).

G. MICHAUXII Spach.

(*G. filipes* Spach.)

In dry, open places, apparently confined to the eastern counties of the State.

Flowers in July and August.

Reported from Jay, Delaware, Randolph, and Wayne (Phinney); Hamilton and Marion.

CIRCÆA L.**C. LUTETIANA L. Enchanter's Nightshade.**

General throughout the State, occurring most abundantly in densely shaded woods.

It flowers from the early part of June through August.

Tippecanoe (Cunningham); Monroe (Blatchley); Fayette (Hessler); Kosciusko (Coulter); Clark (Baird and Taylor); Daviess (Clements); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meynecke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Putnam (MacDougal); Hamilton and Marion (Wilson); Steuben (Bradner).

C. ALPINA L. Smaller Enchanter's Nightshade.

Not uncommon in wet woodlands. Not so abundant as the former, though found in all parts of the State.

Flowers from July to September.

Tippecanoe (Cunningham); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Noble (Van Gorder); Kosciusko (Chipman); Jay, Delaware, Randolph, and Wayne (Phinney); Steuben (Bradner); Carroll.

Probably very often not distinguished from *C. Lutetiana*.

HALORAGIDACEÆ. Water Millfoil Family.

HIPPURIS L.

H. VULGARIS L. Mare's Tail. Joint-weed.

This form, somewhat northern in its general distribution, is reported from two Indiana localities. The cypress swamps of Gibson and Posey counties, reported by Dr. J. Schneck, and from Kosciusko County, by Stanley Coulter. Concerning the latter reference there can be no doubt, as a careful study of the material shows. Dr. Schneck preserved no specimens, but his well known accuracy and the close connection he held with botanical centers leads to a ready acceptance of his citation. These localities extend the southern limits of the species very decidedly, the present limit being "the northern shore of Lake Superior."

Laporte; Lake.

PROSERPINACA L.

P. PALUSTRIS L. Mermaid-weed.

Reported only from Jefferson (J. M. Coulter); Noble (Van Gorder); Gibson and Posey (Schneck); Kosciusko (Coulter).

It should be looked for in July and will probably be found of quite general distribution in the swamp regions of the northern counties.

MYRIOPHYLLUM L.

M. SPICATUM L. Spiked Water Millfoil.

Confined to the northern counties. Reported only from Laporte (Barnes); Noble (Van Gorder), and Steuben (Bradner).

M. VERTICILLATUM L. Whorled Water Millfoil.

This form was added to State flora by W. S. Blatchley, who reports it from Vigo County.

Steuben (Bradner).

M. HUMILE (Raf.) Morong. Low Water Millfoil.

(*M. ambiguum* Nutt.)

Perhaps the most variable form of the genus, at least within our bounds.

Reported from Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck).

M. HETEROPHYLLUM Michx. Various-leaved Water Millfoil.

This form is in condition for collecting in our area in August.

Its reported stations are: Kosciusko (Chipman); Gibson (Schneck); Round Lake (Deam); Steuben (Bradner).

M. PINNATUM (Walt.) B. S. P. Pinnate Water Millfoil.

(*M. scabratum* Michx.)

Reported from Jay, Delaware, Randolph, and Wayne counties by Dr. A. J. Phinney. While Dr. Phinney preserved no specimens, all critical forms were referred to Prof. John M. Coulter. This judgment, added to that of Dr. Phinney, has led to the including of this form in the list of the State flora in the absence of a verifying specimen.

ARALIACEÆ. Ginseng Family.

ARALIA Tourn. Ginseng. Wild Sarsaparilla.

A. SPINOSA L. Angelica Tree. Hercules Club.

Confined to the counties bordering the Ohio River, except as cultivated for ornament. It thrives in lawns as far north as Tippecanoe County, maintaining itself through the severest winters without protection. Its very large, decomposed leaves make it a striking ornamental shrub.

Flowering season, July and August.

The only herbarium specimens are from Jefferson County, though the form has a much wider range in the region indicated.

A. RACEMOSA L. Spikenard.

A widely branching herb, found in rich woodlands in many regions of the State. It is nowhere abundant, but is comparatively of more frequent occurrence in the northern part of the State.

It flowers in July and its large, spicy, aromatic roots furnish a ready means of recognition.

The stations reported are: Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Fayette and Cass (Hessler); Tippecanoe (Cunningham); Putnam (MacDougal); Kosciusko (Coulter); Hamilton (Wilson); Steuben (Bradner); Gibson and Lake.

A. NUDICAULIS L. Wild or Virginian Sarsaparilla.

Occurs in moist woodlands.

Flowers from May to June.

Steuben (Bradner); Gibson. Occurs on dry hillsides, "Shades of Death," Montgomery County. (W. S. B.)

A. HISPIDA Vent. Bristly Sarsaparilla.

In rocky or sandy woods.

Flowers from June to July.

Lake (Hill).

PANAX L.**P. QUINQUEFOLIUM L. Ginseng. "Sang."**

(*Aralia quinquefolia* Descne. and Planch.)

Found only in the southern half of the State and rapidly disappearing because of its commercial value. It is found usually in rich woods, apparently preferring warm, hillside exposures. It is still abundant in Brown County upon the authority of W. S. Blatchley and is reported as not rare in Fayette County by Dr. Hessler. Its quantity, however, has been so greatly reduced that the "sang" gatherers have disappeared.

Jefferson (J. M. Coulter); Monroe and Brown (Blatchley); Fayette (Hessler); Putnam (MacDougal); Hamilton (Wilson); Steuben (Bradner).

P. TRIFOLIUM L. Dwarf Ginseng. Ground-nut.

(*Aralia trifolia* Descne. and Planch.)

This form was first reported from Decatur County by the late Supt. W. P. Shannon.

The species flowers in our range in May and is found only in rich soil.

It is probably of somewhat more extended distribution in the State, as its general range includes Indiana.

Steuben (Bradner).

UMBELLIFERÆ. Carrot Family.**DAUCUS L.****D. CAROTA L. Wild Carrot.**

Abundant in all parts of the State, being in some localities an extremely annoying weed. It is found along roadsides, in waste places and in cultivated fields.

Flowers from June through September.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Daviess (Clements); Franklin (Meyneke); Posey and Gibson (Schneck); Noble (Van Gorder); Tippecanoe (Cunningham); Putnam (MacDougal); Hendricks (Trucksess); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

ANGELICA L.

A. ATROPURPUREA L. Purple-stemmed Angelica.

Confined to the central and northern counties of the State, where it grows somewhat abundantly in swamps and wet grounds.

Flowers in June and July.

Tippecanoe (Cunningham); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Steuben (Bradner); Porter and Lake.

CONIOSELINUM Hoffm.

C. CHINENSE (L.) B. S. P. Hemlock Parsley.
(*C. Canadense* T. and G.)

In the swamps and marshes of the central and northern counties, in considerable abundance.

Flowers in August and September.

Montgomery (Rose); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder).

OXYPOLIS Raf.

O. RIGIDUS (L.) Britton. Cowbane.
(*Tiedmannia rigida* Coult. and Rose.)

Rather widely distributed throughout the State in very wet grounds and at the borders of swamps. An extremely variable form.

Flowers from July until September.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Clark (Baird and Taylor); Vigo (Blatchley); Hamilton and Marion (Wilson).

HERACLEUM L.

H. LANATUM Michx. Cow Parsnip.

In low, wet soils and about lakes in the overflowed bottom lands. Common in the northern counties, becoming less frequent southward.

Flowering season, June and July.

Cass (Hessler); Jay, Delaware, Randolph, and Wayne (Phinney); Kosciusko (Chipman); Marion; Hamilton (Wilson); Steuben (Bradner).

PASTINACA L.

P. SATIVA L. Wild Parsnip.

Found throughout the State in various situations, usually in waste fields, by roadways or in cultivated grounds. It thrives most vigorously in moist soils. A common weed in nearly all parts of the State. Many cases of serious poisoning are reported as caused by this plant, the root being occasionally eaten by mistake or through ignorance.

Flowers from June through September.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Dearborn (Collins); Franklin (Meyneke); Gibson and Posey (Schneck); Putnam (MacDougal); Vermillion (Wright); Decatur (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

POLYTÆNIA DC.

P. NUTTALLII DC.

In dry soil in the "Knob" region of southern Indiana. Reported from several counties, but verified in only one case.

Flowering specimens collected in April.

Floyd (Clapp).

THASPIUM Nutt.

T. TRIFOLIATUM (L.) Britton. Purple Meadow Parsnip.

(*T. aureum atropurpureum* Coult. and Rose.)

Found in many parts of the State, in rich soils in rather open places. It is most frequent in dry situations, although sometimes extending into moist grounds. Probably found in as many localities as the next form, though not so generally reported.

Flowers in June and July.

Vigo (Blatchley); Jefferson (J. M. Coulter); Kosciusko (Coulter); Hamilton and Marion (Wilson); Gibson and Monroe.

T. TRIFOLIATUM AUREUM (Nutt.) Britton.

(*T. aureum* Nutt.)

Widely distributed throughout the State and quite abundant. Usually in rich, moist soils along streams or in damp ravines. Also very common in swamp regions.

Flowers from May through July.

Tippecanoe (Cunningham); Vigo and Monroe (Blatchley); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne

(Phinney); Franklin (Meyncke); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Jennings and Bartholomew (Barnes); Putnam and Union (MacDougal); Marion; Hamilton (Wilson); Lake (Hill).

T. BARBINODE (Michx.) Nutt. Hairy-jointed Meadow Parsnip.

In rich or sandy soils in very many counties of the State, usually found along streams.

Flowering in May and June.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Putnam (MacDougal); Kosciusko (Coulter); Tippecanoe (Cunningham).

LIGUSTICUM.

L. CANADENSE (L.) Britton.

(*L. actæifolium* Michx.)

Exceptional in our area. Found in the central counties in rich soil in shaded places.

Flowering specimens collected in July.

Hamilton (Wilson); Marion.

ERYNGIUM L.

E. AQUATICUM L. Rattlesnake-master. Button Snakeroot.

(*E. yuccifolium* Michx.)

In many counties of the State in considerable abundance. It is frequent in rich, wet soils about lakes, on the borders of prairies and in the "barrens" of the Knobs in Harrison County.

Flowers from July until September.

Tippecanoe (Cunningham); Cass (Hessler); Laporte and Harrison (Barnes); Lake and Vigo (Blatchley); Gibson and Posey (Schneck); Kosciusko (Coulter); Floyd and Washington; Steuben (Bradner).

SANICULA L.

S. MARYLANDICA L. Black Snakeroot.

Widely distributed throughout the State, growing in abundance in rich, rather damp soils in shaded places.

Flowering from May through August.

Jefferson (J. M. Coulter); Clark (Baird and Taylor); Monroe and Vigo (Blatchley); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Cunningham); Fayette (Hessler); Jay, Delaware, Randolph, and Wayne (Phinney); Hamilton (Wilson); Knox (Spillman); Steuben (Bradner).

S. CANADENSIS L.*(S. Marylandica Canadensis Torr.)*

Not so abundant as the preceding, and found in somewhat drier soils. The two species intergrade closely in our area, so that they are separated with difficulty.

Flowers from June through August.

Putnam (MacDougal); Hamilton and Marion (Wilson); Cass (Hessler); Vigo (Blatchley); Jefferson and Lake.

PIMPINELLA L.**P. INTEGERRIMA (L.) Gray. Yellow Pimpernel.**

In several counties of the State, growing in sandy or rocky soils. Not reported from the extreme northern counties.

Flowering in May and June.

Tippecanoe (Cunningham); Jefferson (Barnes); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Monroe (Dudley).

EULOPHUS Nutt.**E. AMERICANUS Nutt.**

Found sparingly in our southwestern counties in dry soil on the borders of prairies.

Flowers from July until October.

Vigo (Blatchley); Gibson and Posey (Schneck).

CHÆROPHYLLUM L.**C. PROCUMBENS (L.) Crantz. Spreading Chervil.**

Abundant in moist, rich soils in rather open places. Also found in sandy soils.

Flowers in April and May.

Jefferson and Kosciusko (Coulter); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Tippecanoe (Golden); Hamilton (Wilson); Fayette (Hessler).

WASHINGTONIA Raf.**W. CLAYTONI (Michx.) Britton. Woolly Sweet Cicely.***(Osmorrhiza brevistylis DC.)*

In damp woods and thickets in many parts of the State. Usually frequent in the stations in which it occurs.

Flowers in May and June.

Jefferson (J. M. Coulter); Vigo and Monroe (Blatchley); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyneke); Gibson and Posey (Schneck); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Golden); Kosciusko (Coulter); Steuben (Bradner).

W. LONGISTYLIS (Torr.) Britton. Smooth Sweet Cicely.

(*Osmorrhiza longistylis* DC.)

In thickets and rich woods throughout the State. Of as wide distribution as the preceding, but not as abundant in its stations.

Flowering in May and June.

Vigo and Monroe (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyneke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Putnam (MacDougal); Kosciusko (Chipman); Hamilton (Wilson); Steuben (Bradner); Tippecanoe.

CONIUM L.

C. MACULATUM L. Poison Hemlock.

Chiefly found in the southern counties in waste places; but nowhere very abundant.

Flowering season, from May until July.

Gibson and Posey (Schneck); Dearborn (Collins); Franklin (Meyneke); Fayette (Hessler).

SIUM L.

S. CICUTÆFOLIUM Gmel. Hemlock Water Parsnip.

Well distributed throughout the State, occurring in wet soils along ditches and borders of ponds; also in swamps and marshes. An extremely variable species.

Flowering in July and August.

Monroe and Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Laporte (Barnes); Noble (Van Gorder); Lake (Hill); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

ZIZIA Koch.

Z. AUREA (L.) Koch. Early Meadow Parsnip.

Specimens sent me by Mr. H. J. Clements are referred to this species. The plant grew in low, wet grounds and was quite plentiful.

Flowering season, from April until June.

Daviess (Clements); Steuben (Bradner); Lake (Hill).

Z. CORDATA (Walt.) DC. Heart-leaved Alexanders.

Occurs in woods.

Flowers in May and June.

Steuben (Bradner).

CARUM L.**C. CARUM L. Caraway. Carvia.**

Occurs occasionally in waste places.

Flowers from May until July.

Steuben (Bradner).

CICUTA L.**C. MACULATA L. Water Hemlock. Spotted Cowbane.**

Distributed throughout the State and occurring plentifully in swamps and ditches and in low wet grounds. The fleshy roots are aromatic; they perhaps furnish the most virulent plant poison in our bounds.

Flowering season, from June until August.

Jefferson: J. M. Coulter; Elkhart (Barnes): Monroe and Vigo (Blanchley): Fayette (Hessler): Dearborn (Collins): Franklin (Merrick): Gibson and Posey (Schneck): Tippecanoe (Cunningham): Jay, Delaware, Randolph, and Wayne (Phinney): Noble (Van Gorder): Clark (Baird and Taylor): Round Lake (Dean): Steuben (Bradner).

C. BULBIFERA L. Bulb-bearing Water Hemlock.

In swamps in the northern part of the State. Neither so widely distributed nor so abundant in its stations as the preceding.

Flowers from July until September.

St. Joseph: J. M. Coulter; Noble: Van Gorder: Cass (Hessler): Round Lake (Dean): Steuben (Bradner): Laporte and Lake.

DEERINGIA Adams.**D. CANADENSIS L. Kuntze. Hogewort.**

Corynorhiza Canadensis DC.

Throughout the State in rich soils of woods and thickets. Quite plentiful wherever found.

Flowering season, June and July.

Tippecanoe (Cunningham): Carroll: J. M. Coulter; Monroe and Vigo (Blanchley): Posey and Gibson (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Merrick); Vermilion (Wright); Fayette (Hessler); Steuben (Bradner).

HYDROCOTYLE L.

H. UMBELLATA L. Marsh Pennywort.

In the northern counties, sparingly found in marshes and other low grounds. Stations numerous, but the plant never abundant.

Flowering season, from June until September.

Noble and Laporte (Barnes); Kosciusko (Coulter); Steuben Bradner); Fulton (Blatchley).

H. AMERICANA L.

I have not seen this species, but it is admitted to the flora upon the authority of Dr. John M. Coulter.

Flowering specimens collected July 15.

Jefferson (J. M. Coulter).

ERIGENIA Nutt.

E. BULBOSA (Michx.) Nutt. Harbinger of Spring. Pepper and Salt. Ground-nut.

Found throughout the State, occurring in damp, rich soil, usually in open woods. Frequently found but nowhere abundant.

Flowering begins in favorable seasons in February, continuing through April.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Daviess (Clements); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Hussey); Kosciusko (Coulter); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

CORNACEÆ. Dogwood Family.

CORNUS L. Dogwood. Cornel.

C. CANADENSIS L. Low or Dwarf Cornel. Bunch-berry.

I have never seen an Indiana specimen of this plant, but it doubtless occurs, at least in the northern tier of counties. A reference of this form to Marion County, no collector's name being given, is doubtless an error. The range of the plant is toward the north, and our northern counties represent pretty fairly the southern limit of the form. The range as given in Britton and Brown (Vol. 2, p. 542) specifically includes Indiana, an inclusion probably based upon the work of E. J. Hill.

C. FLORIDA L. Flowering Dogwood.

Distributed throughout the State, but more abundant and of larger size in the southern half.

Flowers in May and June, according to portion of State in which it is found and exposure.

The wood is very hard and susceptible of a high polish. It varies in color from brown to greenish and reddish tints. While difficult to season, it is used somewhat extensively in turnery, for wood engravings, the bearings of machinery, hubs of wheels, etc. It is reported from almost every county of the State. The species should be preserved where not interfering with agricultural areas, not only on account of its potential value when other more easily-worked timbers are exhausted, but also because its fruit furnishes food for many forms of helpful birds.

C. CIRGINATA L'Her. Round-leaved Dogwood.

This shrub-like dogwood is from eight to ten feet high and is found in rich or sandy soil, in our bounds reaching its highest development in numbers in the latter. It is probably sparsely scattered throughout the State in favorable localities, though definitely reported from only two counties.

Vigo (Blatchley); Lake (Barnes); Hamilton and Marion (Wilson).

C. AMONUM Mill. Silky Cornel. Kinnikinnik.

(*C. sericea L.*)

Distributed throughout the State in wet soils, although nowhere abundant.

Flowers in June.

Reported as follows: Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Fayette (Hessler); Franklin (Meyncke); Falls of the Ohio, 1839 (Clapp); Steuben (Bradner); Lake and Jefferson.

C. ASPERIFOLIA Michx.

A rather tall shrub flowering in May and June. It finds its best development in dry, sandy soil. Its reported stations are: Tippecanoe (Coulter); Putnam (MacDougal); Bartholomew (Barnes); Knox (Spillman).

C. BAILEYI Coult. and Evans.

Found only in sandy soil in the northern portions of the State. Reported from Lake County by Rev. E. J. Hill and from the dune regions of the southern shore of Lake Michigan by Dr. Cowles. In this latter situation it intergrades with *C. stolonifera*, with which it has perhaps been confused.

C. STOLONIFERA Michx. Red-osier Dogwood.

Absent from the extreme southern counties, but abundant in northern counties. It usually is found in wet places, although occurring also in numerous dune associations under xerophytic conditions. Its free multiplication by subterranean suckers or prostrate shoots causes it to form at times extended clumps.

It flowers in June and July.

The reported stations are: Vigo and Monroe (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Barnes); Lake (Hill); Marion; Lagrange (Barnes); Hamilton (Wilson); Steuben (Bradner.)

C. CANDIDISSIMA Marsh. Panicked Cornel.

(*C. paniculata* L'Her.)

Frequents low, wet thickets and is also frequently found along river banks.

Flowers in June.

A diffusely branched shrub, of from three to six feet in height.

Monroe and Vigo (Blatchley); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Jefferson (Coulter); Kosciusko (Chipman); Hamilton and Marion (Wilson); Steuben (Bradner).

C. ALTERNIFOLIA L. f.

Occasionally tree-like in our area, although as a rule a shrub. It is more abundant in the northern part of the State, and also of larger size. In Monroe County it is found chiefly on hillsides, but in the northern counties it is found in thickets in rather dry situations.

The stations are: Tippecanoe (Cunningham); Jefferson (Barnes); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler); St. Joseph (Rothert); Franklin (Meyncke); Hamilton (Wilson); Steuben (Bradner).

The form in Indiana is too small to be of economic value. In many parts of the State it occurs in low, rich woods or on borders of streams and swamps.

NYSSA L. Sour-gum Tree. Tupelo.

N. SYLVATICA Marsh. Black or Sour Gum.

Found in small numbers in many counties, especially in the southern part of the State. Its greatest development both in numbers and size seems to be in the southeastern counties. It is found, however, as far north as Lake and Noble counties. Along streams it reaches considerable size, but in drier localities is much smaller.

Flowering period, April and May.

The uncleavable character of the wood makes it difficult to work, although it is occasionally used in the manufacture of hubs.

Monroe and Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Franklin (Menycke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Putnam (MacDougal); Hamilton (Doane); Steuben (Bradner); Lake; Fayette (Hessler).

N. AQUATICA L. Large Tupelo.

(*N. uniflora* Wang.)

A large tree, sometimes reaching a height of 100 feet, usually found in deep swamps. In Indiana it is found at times removed from swamps, but never in a very dry situation.

It flowers in April.

The wood is soft and as yet is not used in manufacture except occasionally for wood pulp.

Kosciusko (Coulter); Monroe (Blatchley); Putnam (MacDougal); Dearborn (Collins); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Noble (Van Gorder); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Lake (Barnes); Hamilton and Marion (Wilson).

Series 2.

GAMOPETALÆ.

PYROLACEÆ. Wintergreen Family.

PYROLA L.

P. ROTUNDIFOLIA L. Round-leaved Wintergreen.

In the northern counties in dry, sandy soil, usually in shaded places. Nowhere abundant.

Flowers in June and July.

Noble (Van Gorder); Lake; Steuben (Bradner).

P. CHLORANTHA Sw. Greenish-flowered Wintergreen.

In sandy soils in dry localities in the extreme northern part of the State. Not abundant in any station.

Flowers in June and July.

Lake (Hill).

P. ELLIPTICA Nutt. Shin-leaf.

In shaded places in a few counties of the State, chiefly northern. Grows in a rich, sandy loam soil.

Flowering season, July and August.

Lake (Hill); Porter; Steuben; Kosciusko (Chipman); Monroe.

P. SECUNDA L. Serrated Wintergreen.

Of exceptional occurrence in the extreme northern counties. In sandy thickets and dry soil.

Flowers in June and July.

Lake; Porter; Steuben (Bradner).

CHIMAPHILA Pursh.**C. MACULATA (L.) Pursh. Spotted Wintergreen.**

Not uncommon in many counties of the State, growing in dry woods and thickets. Mass distribution in the northern counties.

Flowers in June and July.

Putnam (MacDougal); Franklin (Meyncke); Jefferson; Monroe; Lake; Porter.

C. UMBELLATA (L.) Nutt. Pipsissewa.

Occasionally found in a few counties, chiefly northern. Found in dry soils in shaded places.

Flowers from June until August.

Noble (Van Gorder); Jefferson; Lake; Steuben (Bradner); Monroe.

MONOTROPAEÆ. Indian-pipe Family.**MONOTROPA L.****M. UNIFLORA L. Indian Pipe.**

Widely distributed throughout the State. Of frequent occurrence but in no place abundant. Indicative of rich soil and usually growing in moist woods. It occasionally occurs on dry wooded hillsides in the southern counties.

Flowers from June until August.

Tippecanoe (Cunningham); Cass and Fayette (Hessler); Noble (Van Gorder); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke); Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Putnam (MacDougal); Hamilton (Wilson); Steuben (Bradner).

HYPOPITYS Adans.

H. HYPOPITYS (L.) Small. False Beech-drops.

(*Monotropa Hypopitys* L.)

Occasional in various parts of the State, growing in dry woods. Neither so widely distributed nor abundant as the preceding.

Flowering season, from June until October.

Monroe and Vigo (Blatchley); Cass (Hessler); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Jefferson; Hamilton (Wilson).

ERICACEÆ. Heath Family.

ANDROMEDA L.

A. POLIFOLIA L. Wild Rosemary.

In a few localities in the northern part of the State, growing in sphagnum swamps and peat bogs. Quite abundant in the stations in which it occurs.

Flowers in May and June.

Fulton (Hessler); Noble (Van Gorder); Steuben (Bradner).

CHAMÆDAPHNE Moench.

C. CALYCOLATA (L.) Moench. Leather-leaf.

(*Cassandra calycolata* Don.)

In swampy places in the northern part of the State. Common in its various stations, which are, however, few in number.

Flowering season, April and May.

Fulton (Hessler); Noble (Van Gorder); Lake; Porter; Steuben (Bradner); Starke (Blatchley).

EPIGÆA L.

E. REPENS L. Trailing Arbutus. Mayflower.

Found chiefly in the northern counties in sandy soils. An isolated station is found in Monroe County, where the species grows quite plentifully upon several rocky hillsides.

Flowers in March and April.

Monroe (Blatchley); Laporte (Coulter); Porter (Cowles); Lake and Montgomery.

GAULTHERIA L.

G. PROCUMBENS L. Spring or Creeping Wintergreen.

Confined to the northern counties of the State, growing in wet, pine woods. Extends south as far as Cass County, where it is frequent in wet, shaded places, especially near tamarack swamps.

Flowers in July and August.

Cass (Hessler); Noble (Van Gorder); Lake and Porter; Steuben (Bradner).

Has been taken by me on the "Devil's Back-Bone" at Pine Hills, Montgomery County. (W. S. B.)

ARCTOSTAPHYLOS Adans.

A. UVA-URSI (L.) Spreng. Red Bearberry. Barren Myrtle.

Found only in the dry, sandy soils in the dune regions of the southern shores of Lake Michigan, where it occurs in abundance.

Flowers in May and early June.

Lake and Porter.

VACCINIACEÆ. Huckleberry Family.

GAYLUSSACIA H. B. K.

G. FRONDOSA (L.) T. and G. Tangleberry.

Occasional in southern counties on damp hillsides and in ravines.

Flowering specimens collected May 22.

Clark (Baird and Taylor).

G. RESINOSA (Ait.) T. and G. Black or High-bush Huckleberry.

In various parts of the State, usually quite abundant in the stations in which it is found. It grows in sandy thickets and woods, occasionally being found in sandy open stretches.

Flowers in May and June, fruit ripening in August.

Cass (Hessler); Jefferson (Barnes); Monroe (Blatchley); Clark (Baird and Taylor); Noble (Van Gorder); Lake and Porter; Steuben (Bradner).

VACCINIUM L.

V. CORYMBOSUM L. Tall Blueberry.

In northern part of State in wet, sandy alluvial soils. Not found in drift soils. It ranges somewhat generally in the swamp regions.

Flowers in May and June, fruit ripening late in August or in September.

Herbarium specimens from but one locality.

Cass and Fulton (Hessler); Steuben (Bradner).

V. CANADENSE Richards. Canada Blueberry.

In moist places in the northern part of the State.

Flowering season, from May until June, fruit ripening from July until August.

Steuben (Bradner).

V. PENNSYLVANICUM Lam. Dwarf or Sugar Blueberry.

Widely ranging through the northern counties in thin, dry, sandy soils, usually in open woods.

Flowers in May and June, fruit ripening early in August and largely marketed.

Few definite reports of stations.

Cass (Hessler); Kosciusko (Coulter); Monroe; Lake (Hill).

V. VACILLANS Kalm. Low Blueberry.

In dry, sandy soil, in a few counties. Not abundant in any of its stations.

Flowering in May and June, fruit ripening in August.

Monroe, Lake, and Porter.

V. PALLIDUM Ait. Mountain Blueberry.

(*V. corymbosum pallidum* Gray.)

In the northern counties in sandy soils in woods. Fairly abundant in the stations where it occurs.

Flowering in May and June, fruit ripening in August.

A valuable fruit form.

Noble (Van Gorder); Kosciusko (Coulter); Lake (Hill).

V. STAMINEUM L. Squaw Huckleberry.

Plentiful in many parts of the State, being the prevailing form in the southern counties. Especially abundant in the "Knob" region. Fruit largely marketed.

Flowers in April and May. Fruit ripe in August.

Johnson and Floyd (Barnes); Clark (Baird and Taylor); Lake and Monroe.

OXYCOCCUS Hill.**O. OXYCOCCUS (L.) MacM. Small Cranberry.**

(*Vaccinium Oxycoccus* L.)

In sphagnum swamps and peat bogs in the northwestern part of the State in sparing numbers.

Flowers in June and July. Fruit ripens in September.

Lake (Hill).

O. MACROCARPUS (Ait.) Pers. Large Cranberry.
(*Vaccinium macrocarpon* Ait.)

Common in northern parts of the State in open places, tamarack swamps and peat bogs. Largely marketed from Marshall and adjoining counties.

Flowers in June and July. Fruit ripens in September.

Fulton and Marshall (Hessler); Noble (Van Gorder); Jay (Phinney); Steuben (Bradner).

PRIMULACEÆ. Primrose Family.

HOTTONIA L.

H. INFLATA Ell. Featherfoil.

Reported from a few localities in the southern part of the State. It is found in shallow, stagnant pools adjoining swamps or streams.

Flowers in June and July.

Gibson and Posey (Schneck).

SAMOLUS L.

S. FLORIBUNDUS H. B. K. Water Pimpernel.

(*S. Valerandi Americanus* Gray.)

Throughout the State in marshes, shallow streams and damp shaded places. Of greatest abundance in the southern part of the State.

Flowers from May until September.

Putnam and Vigo (Blatchley); Gibson and Posey (Schneck); Noble (Van Gorder); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Jefferson (J. M. Coulter); Fayette (Hessler); Hamilton (Wilson); Monroe, Marion, and Elkhart; Hamilton (Wilson); Steuben (Bradner).

LYSIMACHIA L.

L. QUADRIFOLIA L. Whorled Loosetrife.

In a few counties of the State, though in no special abundance. In dry shades in rather coarse soil.

Flowering season, June and July.

Clark (Baird and Taylor); Jefferson (J. M. Coulter); Franklin (Meyncke); Tippecanoe (Stevenson); Monroe; Steuben (Bradner).

L. TERRESTRIS (L.) B. S. P. Bulb-bearing Loosestrife.*(L. stricta Ait.)*

Somewhat common in the northern part of the State in swamps and wet shades. It usually grows most freely in black loam.

Flowers in July and August.

Cass (Hessler); Laporte (Barnes); Lake (Hill); Monroe; Steuben (Bradner).

L. NUMMULARIA L. Moneywort.

Found only in the southern part of the State in wet places along the banks of streams. Usually abundant in stations in which it is found.

Flowers in July and August.

Monroe (Blatchley); Clark (Baird and Taylor); Gibson and Posey (Schneck); Franklin (Meyncke); Knox (Spillman); Jefferson.

STEIRONEMA Raf.**S. CILIATUM (L.) Raf. Fringed Loosestrife.**

Widely distributed throughout the State and plentiful in locations found. In moist thickets and low, wet grounds adjoining lakes, in association with *S. lanceolatum*, it frequently covers large areas.

Flowers in July and August.

Vigo (Blatchley); Putnam (MacDougal); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Daviess (Clements); Tippecanoe (Cunningham); Cass (Hessler); Hamilton and Marion (Wilson); Fayette (Hessler); Jefferson, Gibson, Monroe, Carroll, and Elkhart; Steuben (Bradner).

S. LANCEOLATUM (Walt.) Gray. Lance-leaved Loosestrife.

Of wide distribution in the State and usually abundant. It is found in greatest profusion in moist, alluvial soils, growing along ditches and sluggish streams and upon low lake margins. Its habit varies greatly as the water content of the soil changes, the changes being especially noticeable in the leaf.

Flowers in July and August.

Jefferson (J. M. Coulter); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson (Schneck); Monroe and Vigo (Blatchley); Vermillion (Wright); Kosciusko (Chipman); Steuben (Bradner).

S. QUADRIFLORUM (Sims) Hitchc. Prairie Moneywort.
(*S. longifolium* Gray.)

From the north central counties, southward in increasing abundance. Found in moist soils along rivers or about the margins of swamps and lakes.

Flowering in June and July.

Tippecanoe (Cunningham); Cass (Hessler); White (Hussey); Jay, Delaware, Randolph, and Wayne (Phinney); Vigo (Blatchley); Decatur (Ballard); Jefferson, Gibson and Monroe; Steuben (Bradner).

NAUMBURGIA Moench.

N. THYRSIFLORA (L.) Duby. Tufted Loosestrife.
(*Lysimachia thyrsiflora* L.)

Sparingly in moist places in the central and northern parts of the State.

Flowers from May until July.

Tippecanoe (Hussey); Noble (Van Gorder); St. Joseph (Rother); Kosciusko (Chipman); Marion and Lake; Hamilton (Wilson); Steuben (Bradner).

TRIENTALIS L.

T. AMERICANA Pursh. Chickweed. Wintergreen.

Found quite abundantly in certain counties. Especially plentiful in tamarack swamps, which seem to furnish its best conditions.

Flowering season, May and June.

Fulton (Hessler); Noble (Van Gorder); Lake (Hill).

ANAGALLIS L.

A. ARVENSIS L. Poor Man's Weather Glass.

In dry, waste places in the southern part of the State, not being reported north of Monroe County. It is found in considerable abundance along roadsides, usually in a sandy or gravelly soil.

Flowering from May through August.

Jefferson (J. M. Coulter); Clark (Baird and Taylor); Gibson and Posey (Schneck); Monroe.

CENTUNCULUS L.

C. MINIMUS L. False Pimpernel.

Reported from a single station in the southern part of the State.

Flowering specimens collected in April.

Clark (Baird and Taylor).

DODECATHEON L.

D. MEADIA L. Shooting Star. Pride-of-Ohio.

In all parts of the State, but in much greater abundance in the southern part. Found in moist soils and on wet rocks. Occasionally in poor development in dry soil in open places.

Flowers from April through June.

Jefferson (Barnes); Clark (Baird and Taylor); Delaware, Jay, Randolph, and Wayne (Phinney); Dearborn (Collins); Franklin (Meyncke); Gibson and Posey (Schneck); Monroe (Blatchley); Noble (Van Gorder); Owen (MacDougal); Tippecanoe (Cunningham); Cass and Fayette (Hessler).

EBENACEÆ. Ebony Family.

DIOSPYROS L.

D. VIRGINIANA L. Persimmon. 'Possum Plum.

Abundant in the southern counties, where it reaches its greatest development. According to Ridgway, in the southwestern counties it exceptionally reaches a height of 115 feet and a diameter of two feet. It occurs but rarely north of the central counties.

The wood is heavy, strong, compact and susceptible of a high polish. It is used for shoe-lasts, plane-stocks, etc., and is preferred to all other woods for shuttles. In old trees the heart wood is very dark, being almost black. The timber will undoubtedly come into general use for special articles of manufacture and should be preserved. The persimmon is now being largely cultivated for its fruit, the persimmon orchards in Orange County supplying a constantly increasing market. At least three types, varying sharply in fruit characters, are distinguished popularly, though not recognized botanically.

Flowers in May and June. Fruit ripe after a few sharp frosts.

Jefferson and Tippecanoe (Coulter); Orange (Troop); Gibson and Posey (Schneck); Clark (Baird and Taylor); Floyd (Clapp); Monroe and Vigo (Blatchley).

STYRACACEÆ. Storax Family.

MOHRODENDRON Britton.

M. CAROLINUM (L.) Britton. Rattle Box. Snowdrop Tree.

(Halesia tetraptera L.)

Reported only from near Evansville. A tree 35 to 50 feet high and from 15 to 20 inches in diameter, with light, soft-grained, compact wood of light-brown color.

Flowers in April and May.

Vanderburgh.

OLEACEÆ. Olive Family.

FRAXINUS L.

F. AMERICANA L. White Ash.

Generally distributed throughout the State, usually in rich soils. In wet lands it becomes greatly enlarged at the base. A large tree of the highest economic value. In common with many of the hardwood forms of the United States, it reaches its highest development in the lower Wabash basin. According to Ridgway, a height of 140 feet is not uncommon, and clean trunks of from 80 to 90 feet are occasionally found. Its uses are too well known to need repetition.

Flowering season, April and May.

Distribution so general as to make the mention of specific stations needless.

F. LANCEOLATA Borck. Green Ash.

(F. viridis Michx. f.)

Rather abundant in the southern part of the State, less so farther north. The species finds its highest development in low, rich bottom lands along streams. The form reaches a height of from 50 to 60 feet and a diameter of from 18 to 24 inches. The wood is much inferior in quality to that of the white ash, for which it is often substituted.

Flowering season, April and May.

The range includes the southern counties, the form extending northward chiefly along the lines of the principal drainage channels.

F. PENNSYLVANICA Marsh. Red Ash.

(F. pubescens Lam.)

This species is found sparingly in a few counties of the State, growing along the borders of streams in moist alluvial soils. It

reaches a height in our area of from 40 to 60 feet, rarely exceeding two feet in diameter. The wood is much less valuable than that of the white ash, with which, however, it is often confounded.

Flowering season, April and May.

Reported from following counties: Tippecanoe (Cunningham); Floyd and Knox; Gibson.

F. CAROLINIANA Mill. Water Ash.

(*F. platycarpa* Michx.)

Found in cypress swamps in the southwestern counties. Collected in quantity by Dr. J. Schneck and verified by him at the Shaw Botanical Gardens, St. Louis. Flowers in March and April.

F. QUADRANGULATA Michx. Blue Ash.

A tall, slender tree found sparingly in nearly every part of the State. Its usual location is in hilly regions, although occasionally extending its range to bottom lands. Its highest development is in the rich alluvial soils of the lower Wabash, where it exceptionally reaches a height of from 100 to 115 feet. The wood is heavy and hard, but not strong. It is largely used for flooring and in carriage building.

Flowering season, March and April.

As it ranges through the State, its specific stations are omitted.

F. NIGRA Marsh. Black Ash. Hoop Ash. Water Ash.

(*F. sambucifolia* Lam.)

Well distributed through the State, though never in very great abundance. From 80 to 100 feet high and from 18 to 24 inches in diameter. Wood not strong, but easily separating into thin layers, giving it especial value in interior finish, cabinet making, for barrel hoops, basket making, etc.

Flowering season, April and May.

Specific stations omitted because of general range.

ADELIA P. Br.

A. ACUMINATA Michx. Privet.

(*Forestiera acuminata* Poir.)

This southern form is reported as occurring only in Gibson and Posey counties. It is a small tree of from 20 to 30 feet in height and of a diameter of about six to eight inches. Not frequent and of no economic value. Found usually in low, wet alluvial soils.

Flowers in March and April.

Gibson and Posey.

LOGANIACEÆ. *Logania* Family.

SPIGELIA L.

S. MARYLANDICA L. Indian or Carolina Pink.

A showy plant growing in rich woods. Reported from a single county.

Flowering season from May until July.

Marion (Moffatt).

GENTIANACEÆ. *Gentian* Family.

SABBATIA Adans.

S. ANGUSTIFOLIA (Michx.) Britton. Narrow-leaved *Sabbatia*.

(*S. brachiata* Ell.)

Occasional in the southern part of the State in somewhat clayey moist soils. Reported definitely from a single county.

Flowering from May until August.

Jefferson (J. M. Coulter).

S. ANGULARIS (L.) Pursh. Rose-Pink.

In various counties usually in moist and rich sandy loams, near the borders of lakes or the lowlands of sluggish streams. Frequently found in considerable profusion in almost pure sand on the beaches of the smaller inland lakes. The flowers are very attractive and slightly fragrant.

Flowers in July and August.

Tippecanoe (Cunningham); Cass (Hessler); Franklin (Meyncke); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Gibson and Posey (Schneck); Kosciusko (Coulter); Lake (Blatchley).

GENTIANA L.

G. CRINITA Froel. Fringed *Gentian*.

In damp, usually rich soils, in open woods or meadows. Quite frequent in its range, but never abundant. Confined to the central and northern counties, not being reported south of Marion County.

Flowers in September and October.

Cass (Hessler); Noble (Van Gorder); Wayne (Phinney); Kosciusko (Chipman); Marion (Hessler); Steuben (Bradner); Lake and Wabash (Blatchley).

G. DETONSA Rottb. Smaller Fringed Gentian.*(G. serrata* Gunner.)

Sparingly found in a few counties in damp soils, in the northern part of the State. The stations are not infrequent, but only a few plants are found in any locality.

Flowers in August and September.

Tippecanoe (Cunningham); Noble (Van Gorder).

G. QUINQUEFOLIA L. Stiff Gentian. Ague-weed.*(G. quinqueflora* Lam.)

Found in widely separated counties, usually in moist, hillside thickets, less commonly in low grounds. Probably to be found throughout the State.

Flowers in September and October.

Tippecanoe (Cunningham); Franklin (Meyncke); Noble (Van Gorder); Vigo (Blatchley); Marion; Steuben (Bradner); Fayette (Hessler).

G. QUINQUEFOLIA OCCIDENTALIS Gray.*(G. quinqueflora occidentalis* Gray.)

Reported only from the "Knob" region in southern Indiana, where it was collected by Dr. Clapp in 1837. No subsequent record for the State.

Floyd (Clapp).

G. PUBERULA Michx. Downy Gentian.

Found in southern counties of the State in open places in dry soil. Name of collector not accompanying specimens.

Flowering in August and September.

Harrison and Washington.

G. SAPONARIA L. Soapwort Gentian.

Occasional in wet soils in open places. Perhaps found in many counties, but of definite report only by Mr. Blatchley.

Collected in flower in September.

Vigo (Blatchley); Lake and Laporte.

G. ANDREWSII Griseb. Closed Gentian.

Of general distribution throughout the State, growing in moist, rich soils, in shaded places. Quite abundant in the stations in which it is found.

Flowers in September and October.

Tippecanoe (Dorner); Cass and Fayette (Hessler); Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Franklin (Meyncke); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Hamilton (Wilson); Steuben (Bradner).

G. FLAVIDA A. Gray. Yellowish Gentian.

(*G. alba* Gray.)

Widely distributed in moist, rich soils and usually quite frequent in its stations.

Flowers in September and October.

Tippecanoe (Cunningham); Vigo and Monroe (Blatchley); Cass (Hessler); Noble (Van Gorder); Gibson and Posey (Schneck); Steuben (Bradner); Lake.

FRASERA Walt.

F. CAROLINENSIS Walt. American Columbo.

In many counties of the State in dry, rich soils, but nowhere common.

Flowers from May until in July.

Cass (Hessler); Franklin (Meyncke); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Decatur and Shelby (Ballard); Kosciusko (Chipman); Steuben (Bradner); Tippecanoe; Monroe and Vigo (Blatchley).

OBOLARIA L.

O. VIRGINICA L. Pennywort.

Confined to the southern counties of the State, where it is occasionally found in rich woods and thickets. The species probably entered our flora from the south. Not reported from north of Monroe and Vigo counties.

Flowering season, April and May.

Vigo and Monroe (Blatchley); Jefferson (Barnes); Gibson and Posey (Schneck); Clark (Baird and Taylor).

BARTONIA Muhl.

B. VIRGINICA (L.) B. S. P. Yellow Bartonian.

(*B. tenella* Muhl.)

In moist soil in open woods.

Flowering season from July to September.

Lake (Hill).

MENYANTHACEÆ. Buckbean Family.

MENYANTHES L.

M. TRIFOLIATA L. Marsh Bean. Bean Trefoil.

In peat bogs and sphagnum swamps in the northern counties only, extending through the line of swamps and small lakes as far south as Cass County. Abundant in its various stations.

Flower season in our area, May and June.

Kosciusko (Chipman); Cass, Fulton, and Marshall (Hessler); Noble (Van Gorder); Lake (Hill); St. Joseph (Rothert); Steuben (Bradner); Starke (Blatchley).

APOCYNACEÆ. Dogbane Family.

AMSONIA Walt.

A. AMSONIA (L.) Britton.

(*A. Tabernemontana* Walt.)

Reported from a single station in the southern part of the State. Abundant herbarium material verifies the reference. Grows in moist soil.

Collected in flower May 27, 1894.

Daviess (Clements); Gibson and Posey.

VINCA L.

V. MINOR L. Periwinkle. Myrtle.

Largely escaped from cultivation, especially in southern parts of the State. Large areas are frequently entirely taken by the species.

Flowers very early, February through May.

Hamilton and Marion (Wilson); Montgomery.

APOCYNUM L.

A. ANDROSEMIFOLIUM L. Spreading Dogbane.

Found in several counties of the State, usually in dry, sandy soil. More abundant in the northern than in the southern counties. Found in field and thickets.

Flowers in July and August.

Tippecanoe (Cunningham); Cass (Hessler); St. Joseph (Barnes); Lake (Hill); Vigo (Blatchley); Kosciusko (Coulter); Hamilton (Wilson); Steuben (Bradner).

A. CANNABINUM L. Indian Hemp.

In fields and thickets, of wider distribution and more abundant than the preceding. It is frequently a very attractive plant in dry, open fields, where in some localities it is the dominant plant form.

Flowers from July to September.

Tippecanoe (Cunningham); Daviess (Clements); Cass and Fayette (Hessler); Vermillion (Wright); Jefferson and Kosciusko (Coulter); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

ASCLEPIADACEÆ. Milkweed Family.**ASCLEPIAS L.****A. TUBEROSA L. Butterfly Weed. Pleurisy Root.**

One of the most brilliant of the genus in our bounds. Widely distributed and very abundant. It is found in dry soil, sandy or gravelly, and at times gives character to miles and miles of railroad embankments.

Begins flowering in June, but the mass flowering being in August.

Clark (Baird and Taylor); Dearborn (Collins); Daviess (Clements); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Owen (MacDougal); Tippecanoe (Cunningham); Vigo (Blatchley); Kosciusko (Coulter); Hamilton (Wilson); Steuben (Bradner); Cass and Marshall (Hessler).

A. PURPURASCENS L. Purple Milkweed.

Found in many counties in dry fields and thickets, and along roadsides. Frequently associated with *A. tuberosa*. The form is very difficult at times to separate from the preceding, almost perfect intergradations occurring where the species grow together over large areas.

Flowering season July to October.

Daviess (Clements); Vigo (Blatchley); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Gibson and Posey (Schneck); Franklin (Meyncke); Hamilton (Wilson); Kosciusko (Coulter).

A. INCARNATA L. Swamp Milkweed.

Found in marshes and wet soils throughout the State. Of greater abundance in the northern part.

Flowering from July through September.

Tippecanoe (Cranningham); Ives (Clements); Jefferson (J. M. Coulter); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyneke); Gibson and Posey (Schneck); Fayette (Hessler); Vigo (Blatchley); Kosciusko (Conizer); Hamilton and Marion (Wilson); Steuben (Bradner).

A. PULCHRA Ehrh. Hairy Milkweed.

(*A. incarnata pulchra* Pers.)

Found in similar localities and associated with the preceding. Very difficult to separate the two forms, where they grow together in large quantities. This species and *incarnata* probably have the same range, but definite reports have come from only two counties.

Flowers July through September.

Jefferson (J. M. Coulter); Carroll.

A. OBTUSIFOLIA Michx. Blunt-leaved Milkweed.

An early flowering form occurring in dry, sandy soils in a few counties in the State. It is nowhere abundant but probably of wider distribution than the reports indicate.

Flowers from May through the summer.

Tippecanoe (Hussey); Floyd (Clapp); Lake and Vigo (Blatchley); Clark (Baird and Taylor); Gibson (Schneck).

A. EXALTATA (L.) Muhl. Poke Milkweed. Tall Milkweed.

(*A. phytolaccoides* Pursh.)

In thickets and woods in moderately damp soil throughout the State. In many collections confused with *A. variegata*, a much less widely distributed form.

Flowers in June and July, extending through September.

Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyneke); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Hussey); Fayette (Hessler); Kosciusko (Chipman); Vigo (Blatchley); Hamilton (Wilson); Steuben (Bradner).

A. VARIEGATA L. White Milkweed.

In dry woods and thickets, never very abundant and confined largely to the southern counties of the State. It prefers sandy or gravelly soils, though occasionally found in clays.

Flowering season short, covering June and July.

Daviess (Clements); Monroe (MacDougal); Gibson and Posey (Schneck); Noble (Van Gorder); Clark (Baird and Taylor); Vigo (Blatchley); Jefferson and Marion.

A. QUADRIFOLIA Jacq. Four-leaved Milkweed.

A form of wide distribution, easily recognized by the middle leaves being usually in whorls of four. It is found in thickets or light woods usually in sandy or light, dry soil.

Flowers from May until the latter part of July.

Clark (Clapp); Jefferson (Barnes); Daviess (Clements); Dearborn (Collins); Franklin (Meyncke); Gibson and Posey (Schneck); Jay, Delaware, Randolph and Wayne (Phinney); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Coulter); Floyd (Clapp); Monroe and Vigo (Blatchley); Fayette (Hessler); Decatur and Shelby (Ballard).

A. SYRIACA L. Common Milkweed. Silkweed.

(*A. Cornuti* Decaisne.)

The most abundant member of the genus in the State, and of general recognition. It grows in fields and waste places, usually in rather dry soils, although at times found in good development in the low, damp grounds adjoining lakes.

Flowering from June through August.

Tippecanoe (Coulter); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Noble (Van Gorder); Franklin (Meyncke); Clark (Baird and Taylor); Dearborn (Collins); Decatur and Shelby (Ballard); Fayette (Hessler); Monroe and Vigo (Blatchley); Hamilton (Wilson); Steuben (Bradner).

A. PERENNIS Walt. Thin-leaved Milkweed.

Found in wet soils, chiefly the low bottom lands along streams in a few southern counties.

Flowers from May through summer.

Owen (MacDougal); Gibson and Posey (Schneck); Clark (Baird and Taylor); Jefferson (Coulter); Daviess (Clements).

A. VERTICILLATA L. Whorled Milkweed.

Easily recognized by its narrowly linear, sessile leaves which are whorly arranged in whorls of from three to seven. A dry soil form, ordinarily found on high ground in sandy soil. More abundant in the western part of its range.

Flowers from July until September.

St. Joseph (Barnes); Clark (Baird and Taylor); Cass and Marshall (Hewes); Vigo (Blatchley).

ACERATES EIL.**A. VIRIDIFLORA Raf., Eaton. Green Milkweed.**

The species in our State is confined in its mass distribution to dry, sandy soils of the northern counties. It is occasionally found in rocky regions farther south.

Flowers from June through September.

St. Joseph (Barnes); Tippecanoe (Hussey); Clark (Baird and Taylor); Lake (Hill); Elkhart; Steuben (Bradner).

A. FLORIDANA (Lam.) Hitchc.

(*A. longifolia* EIL.)

Found in moist, rich soils, usually the loams along streams or about small inland lakes. More common in the northern counties, occasionally found, however, in the southern part of the State.

Flowers from June through September.

Tippecanoe (Cunningham); Cass (Heseler); Jasper (Barnes); Gibson and Posey (Schneck); Kosciusko (Coulter).

AMPELANUS Raf.**A. ALBIDUS (Nutt.) Britton.**

(*Enslenia albida* Nutt.)

A trailing form that has entered our flora from the south. Confined to the southern counties, its northern record being Vigo County. It is found growing in wet soils usually on the banks of streams or in bottom land thickets. Usually abundant in the stations where it occurs.

Flowers in June and July.

Jefferson (Barnes); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Vigo (Blatchley).

VINCETOXICUM Walt.

V. GONOCARPOS Walt. Large-leaved Angle-pod.

(Gonolobus levis macrophyllus Gray.)

In moist thickets in the southern part of the State. Herbarium specimens are labelled "southern Indiana," so no definite counties can be given. The collections were probably made in the southwestern counties, the form having entered our flora from the south rather than the east.

V. GONOCARPOS LEVIS (Michx.) Britton.

(Gonolobus levis Michx.)

Along the banks of streams in rich, wet soils, in the southwestern counties. Of sparing occurrence.

Gibson and Posey (Schneck).

CONVOLVULACEÆ. Morning-glory Family.

QUAMOCLIT Moench.

Q. COCCINEA (L.) Moench. Cypress Vine. Indian Pink.

(Ipomœa Quamoclit L.)

Escaped from gardens somewhat extensively in the southern part of the State. It nowhere wanders far from its original station, not leaving cultivated grounds, or those recently abandoned. Apparently unable to maintain itself in the midst of the original plants of the area.

Flowers in July and August.

Clark (Baird and Taylor); Gibson and Posey (Schneck); Jefferson.

IPOMCEA L.

I. PANDURATA (L.) Meyer. Man-of-the-Earth. Wild Potato Vine.

Abundant in sandy soils and cultivated fields in many parts of the State. The trailing or climbing weak stems give little evidence of the enormous fleshy root from which they spring. This root habit makes it very difficult to exterminate when it has fairly established itself and has given it a place among the worst weeds in many localities.

Flowering begins in May and continues through the summer.

Tippecanoe (Cunningham); Jefferson and Kosciusko (Coulter); Clark (Baird and Taylor); Dearborn (Collins); Gibson and Posey (Schneck); Noble (Van Gorder); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Decatur (Ballard); Fayette (Hessler); Vigo (Blatchley).

L. LACINOSA L. Small flowered White Morning-glory.

Abundant in wet soil in many portions of the State. Along meadow streams and in the low lands about lakes it is frequently the prevailing plant form. Much more abundant in the southern counties.

Flowers from July until October.

Tippecanoe (Cunningham); Jefferson (Barnes); Clark (Baird and Taylor); Gibson and Posey (Schneck); Franklin (Meyncke); Vigo (Blatchley); Kosciusko (Coulter); Hamilton and Marion (Wilson).

L. PURPUREA L. Red Morning-glory.

Escaped from cultivation in all parts of the State occurring in waste grounds or invading cultivated fields. As an escape it flowers with less profusion than when under cultivation and the flowers are smaller.

Flowers from July through September.

Jefferson (Barnes); Dearborn (Collins); Clark (Baird and Taylor); Gibson and Posey (Schneck); Noble (Van Gorder); Franklin (Meyncke); Jay, Indiana, Randolph, and Wayne (Phinney); Daviess (Clements); Decatur (Ballard); Vigo (Blatchley); Hamilton and Marion (Wilson).

L. HEDERACEA Jacq. Ivy-leaved Morning-glory.

Of less general distribution than the preceding, but occurring in similar locations. Also found in alluvial soils along streams. In common with the other members of the genus, it prefers soils with an admixture of sand.

Kosciusko (Chipman); Putnam (MacDougal); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Dearborn (Collins); Clark (Baird and Taylor); Franklin (Meyncke); Marion; Fayette (Hessler); Vigo (Blatchley); Hamilton (Wilson).

CONVOLVULUS L.**C. SEPIUM L. Hedge Bindweed.**

(*C. sepium Americanus* Sims.)

A moist soil form in fields and thickets. Frequently very abundant and annoying. Widely distributed in situations indicated and also in alluvial sands.

Flowers from June through September.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Putnam (MacDougal); Noble (Van

Gorder); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Decatur (Ballard); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

C. REPENS L.

In dry soils in the central part of the State. Somewhat common where found.

Hamilton and Marion (Wilson); Steuben (Bradner).

C. SPITHAMAEUS L. Upright Bindweed.

Not uncommon in dry, sandy or rocky situations, more frequently upon hills and banks. Neither so widely distributed nor abundant as the preceding. Easily recognized by the two large bracts which nearly enclose the calyx.

Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); St. Joseph (Rotherth); Jefferson and Floyd.

C. ARVENSIS L. Small Bindweed.

In fields and waste places in several parts of the State, in dry, preferably sandy or gravelly soils. Known locally in a few places as "cornbind."

Flowers from May through August.

Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Marion (Hessler); Lake (Hill); Vigo (Blatchley).

CUSCUTACEÆ. Dodder Family.

CUSCUTA L.

C. ARVENSIS Beyrich. Field Dodder.

Sparingly found throughout the State in fields upon various herbs, rarely upon low shrubs. The difficulty of discrimination in this genus has resulted in most botanists leaving the species severely alone, hence the reports upon distribution are relatively meagre.

Flowers in July and August.

Dearborn (Collins); Lake (Hill).

C. POLYGONORUM Engelm. Smart-weed Dodder.

(*C. chlorocarpa* Engelm.)

One of the most abundant of our dodders. It is found in very great abundance in moist, rich soil, parasitic upon various species

of *Polygonums* and other herbs. It attacks almost any fairly succulent herbaceous plant and makes a remarkably rapid growth when it has secured attachment to the host. Its orange-yellow color makes it of fairly easy recognition. It is very difficult to exterminate when it has once obtained a foothold.

Flowers from late in July until September. More abundant in northern counties.

Marion and Lake; Vigo (Blatchley); Kosciusko (Coulter); Tippecanoe (Wright); Montgomery (J. M. Coulter).

C. CEPHALANTHI Engelm. Button-bush Dodder.

(*C tenuiflora* Engelm.)

Parasitic upon shrubs and tall, hard-stemmed herbs. In our area more frequently found upon the Button-bush than any other form. Probably found throughout the State, but definitely reported from but few counties.

Flowers in July and August.

Lake (Hill); Hamilton (Wilson).

C. GRONOVII Willd. Common Dodder.

Our most widely distributed and abundant form. Parasitic on herbs and low shrubs, and preferring rather moist soils, though thriving well in dry fields. All the *Cuscutas* are variable, but this species has a very wide range of variation in both habit and character of its station.

Flowers in July and August.

Jefferson (Barnes); Putnam (MacDougal); Clark (Baird and Taylor); Gibson and Posey (Schneck); Noble (Van Gorder); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler); Hamilton (Wilson); Vigo (Blatchley); Steuben (Bradner).

C. COMPACTA Juss. Compact Dodder.

Not uncommon on shrubs, but not nearly so abundant as the preceding forms. It has probably not been separated by collectors from *C. Gronovii* on the one hand and *C. paradoxa* on the other. In our range it is ordinarily found in rather dry regions, and seems better able to resist excess sunlight than the other members of the genus.

Flowers in July and August.

Posey and Gibson (Schneck); Montgomery (Cunningham).

C. PARADOXA Raf. Glomerate Dodder.*(C. glomerata Choisy.)*

A very characteristic species parasitic upon the larger compositæ. Found also upon other strong herbs. The flower clusters run together, forming dense masses, so that at times, the host plants seems to be encircled with a small rope. These confluent flower masses are frequently over an inch wide and deep. With us the species seems to prefer the Great Ragweed, though also largely found upon various species of sunflower.

Flowers from July through September.

Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Noble (Van Gorder); Tippecanoe (Cunningham); Jefferson (Barnes); Kosciusko (Coulter); Hamilton and Marion (Wilson); Harrison.

POLEMONIACEÆ. Phlox Family.**PHLOX L.****P. PANICULATA L. Garden Phlox.**

Found in many parts of the State in shaded places, usually in rich moist soils. A favorite location is near streams or in their bordering thickets.

Flowers in June, continuing through August.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Vigo (Blatchley); Putnam (MacDougal); Jay (Phinney); Dearborn (Collins); Clark (Baird and Taylor); Franklin (Meyncke); Gibson and Posey (Schneck); Fayette (Hessler); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson).

P. MACULATA L. Wild Sweet-William.

In many counties growing in soils either on the borders of open places or in deep woods. It is for the most part indicative of rich soil. White forms also occur in some localities.

Flowers in June and July.

Monroe and Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Gibson and Posey (Schneck); St. Joseph (Rothert); Decatur and Shelby (Ballard); Tippecanoe (Coulter); Hamilton (Wilson); Fayette (Hessler).

P. OVATA L. Mountain Phlox.

Reported only from the hill regions of southern Indiana. The form is of the mountains, and its extension of range into Indiana is questionable. Admitted on herbarium specimens labelled as from "southern Indiana."

Flowers in June and July.

Clark (Baird and Taylor); Jefferson.

P. GLABERRIMA L. Smooth Phlox.

Well distributed through the State in moist, rich soils, occurring on prairies or in rather light woods. It is possible that the forms referred to *P. ovata* are broad-leaved forms of this species.

Begins to flower in May, and continues through August.

Tippecanoe (Hussey); Jefferson and Jasper (Barnes); Clark (Baird and Taylor); Daviess (Clements); Gibson and Posey (Schneck); Jay (Phinney); Vigo (Blatchley); Vermillion (Wright).

P. PILOSA L. Downy Phlox.

In dry, rather sandy, loose soil in the northern counties; in damp prairies and borders of woods in the southern counties. Distributed widely, but more abundant in the northern part of its range.

Flowers from April through June.

Tippecanoe (Cunningham); Daviess (Clements); Johnson (Barnes); Vigo (Blatchley); Noble (Van Gorder); Jefferson (J. M. Coulter); Dearborn (Collins); Clark (Baird and Taylor); Gibson and Posey (Schneck); St. Joseph (Rothert); Knox (Spillman); Steuben (Bradner); Cass (Hessler).

P. AMGENA Sims. Hairy Phlox.

A species entering our flora from the south and confined to the southern counties where it is sparingly found. Occurs in dry, upland places.

Flowering in May and June.

Jefferson (J. M. Coulter); Gibson and Posey (Schneck).

P. DIVARICATA L. Wild Blue Phlox.

The most widely distributed and abundant species of the genus. It is found in ravines, open woods, thickets or wherever moist, rich soil and shade occur. Usually very abundant in thickets bordering streams.

Flowering from April through June.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke); Gibson and Posey (Schneck); Vermillion (Wright); Knox (Spillman); Decatur and Shelby (Ballard); Fayette and Cass (Hessler); Hamilton and Marion (Wilson).

P. BIFIDA Beck. Cleft Phlox.

On sandy hillsides and dry open woods in several counties. Ordinarily in considerable quantity in the stations where found. Probably of general occurrence.

Flowers in April and May, at times continuing through June in the northern part of the State.

Lake, Starke, Vigo, and Monroe (Blatchley); Tippecanoe (Coulter).

P. SUBULATA L. Ground or Moss Pink.

In extremely dry, sandy or rocky soils. Its low habit of growth and botanically unpromising stations have doubtless prevented more numerous reports of its occurrence. Probably found in most of the northern counties.

Flowers from April through June.

Tippecanoe (Cunningham); Clark (Baird and Taylor); Kosciusko (Coulter); Jefferson and Montgomery.

POLEMONIUM L.

P. REPTANS L. Jacob's Ladder. Greek Valerian. Blue-bells.

In shaded, rather damp places throughout the state. The Indiana forms are of stronger stem habit, and the entire plant more hairy than indicated by descriptions. The same is true of Illinois forms examined. A comparison with eastern material at the Gray herbarium shows that the western form is easily distinguished by the characters indicated.

Flowers in April and May.

Tippecanoe (Cunningham); Hamilton and Marion (Wilson); Daviess (Clements); Jefferson (Barnes); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Dearborn (Collins); Clark (Baird and Taylor); Franklin (Meyncke); Gibson and Posey (Schneck); Monroe and Vigo (Blatchley); Putnam (MacDougal); Vermillion (Wright); St. Joseph (Kizer); Decatur (Ballard); Fayette (Hessler); Knox (Spillman).

HYDROPHYLLACEÆ. Water-leaf Family.

HYDROPHYLLUM L.

H. VIRGINICUM L. Virginia Water-leaf.

In shaded places, in moist, rich soils. Of much greater abundance in the southern counties, though found in suitable localities in the northern tier of counties.

Flowers from April until August.

Tippecanoe (Cunningham); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Vigo (Blatchley); Noble (Van Gorder); Franklin (Meyncke); Clark (Baird and Taylor); Decatur (Ballard); Fayette (Hessler); Steuben (Bradner).

H. MACROPHYLLUM Nutt. Large-leaved Water-leaf.

In rich, damp situations in woods and ravines. Not so abundant as the other species of the genus, but found in greater or less numbers in every part of the State. More common in southern counties.

Flowers in May and June.

Tippecanoe (Cunningham); Jefferson (Barnes); Vigo (Blatchley); Putnam (MacDougall); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Franklin (Meyncke); Clark (Baird and Taylor); Fayette (Hessler); Hamilton and Marion (Wilson).

H. APPENDICULATUM Michx.

In the same soils as the preceding. Found throughout the State and quite abundant wherever the conditions of wet soil and light shade are found.

Flowers in May and June.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Clark (Baird and Taylor); Monroe and Vigo (Blatchley); Putnam (MacDougall); Noble (Van Gorder); Franklin (Meyncke); Decatur (Ballard); St. Joseph (Rothert); Fayette (Hessler); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

H. CANADENSE L. Broad-leaved Water-leaf.

In woods and the sides of deep ravines. The species requires more shade than the other members of the genus and is apparently less dependent upon soil moisture. Not specially common.

Flowers in June and July.

Vigo and Monroe (Blatchley); Jefferson (J. M. Coulter); Putnam (MacDougal); Clark (Baird and Taylor); Laporte.

MACROCALYX Trew.**M. NYCTELEA (L.) Kuntze.**

(*Ellisia Nyctelea* L.)

Found only in moist soils in the southern part of the State. Added to the flora by W. S. Blatchley.

Flowers in April and May.

Vigo (Blatchley); Knox (Spillman).

PHACELIA Juss.**P. BIPINNATIFIDA Michx. Loose-flowered Phacelia.**

Common in the southern counties of the State in moist, rich soils, usually in hilly places or in woods. The only northern report is from Cass County.

Flowers in April and May.

Daviess (Clements); Cass (Hessler); Jefferson (Barnes); Clark (Baird and Taylor); Franklin (Meyncke); Gibson and Posey (Schneck); Vigo (Blatchley); Hamilton and Marion (Wilson).

P. PURSHII Buckley.

A very beautiful form quite widely distributed, and having its best development in moist, rich soils. It is also found in sandy, open woods and has invaded fields in some cases as a weed.

Flowers from April through June.

Tippecanoe (Cunningham); Cass (Hessler); Dearborn (Collins); Clark and Jefferson (Barnes); Vigo (Blatchley); Noble (Van Gorder); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Decatur and Shelby (Ballard); Fayette (Hessler); Marion; Hamilton (Wilson).

BORAGINACEÆ. Borage Family.**HELIOTROPIUM L.****H. INDICUM L. Wild Heliotrope.**

Sparingly found in waste places and along streams in the southern counties of the State.

Flowering season, from May until the frosts.

Deviens (Clements); Jefferson (Barnes); Clark (Baird and Taylor); Gibson and Posey (Schneck); Vigo (Blatchley).

CYNOSLOSSUM L.

C. OFFICINALE L. Hound's Tongue.

Abundant throughout the State in waste places and along roadsides. Ordinarily found in dry, coarse soil. The form is easily recognized by means of its fetid odor and purple corolla.

Flowering season, from May until October.

Tippecanoe (Cunningham); Hamilton and Marion (Wilson); Jefferson (Barnes); Putnam (MacDougal); Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Vermillion (Wright); Decatur and Shelby (Ballard); Fayette (Hessler); St. Joseph (Rother); Vigo (Blatchley); Steuben (Bradner).

C. VINOSUM L. Wild Comfrey.

In more shaded places, preferring rather dry soils. Less widely distributed and less common than preceding.

Flowers from June through August.

Tippecanoe (Cunningham); Deviens (Clements); Clark (Barnes); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Franklin (Meyncke); Gibson and Posey (Schneck); Vigo (Blatchley); Steuben (Bradner).

LAPPULA Moench.

L. LAPPULA (L.) Karst. Stickseed. Barweed.

(*Echinoperrum Lappula* Lehm.)

Throughout the State in open waste places and abandoned fields in dry soil. In certain localities an annoying weed.

Flowers from April until August.

Tippecanoe (Cunningham); Jennings and Bartholomew (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Noble (Van Gorder); Jefferson (J. M. Coulter); Franklin (Meyncke); Gibson and Posey (Schneck); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

L. VIRGINIANA (L.) Greene.*(Echinosperrnum Virginicum Lehm.)*

Common in all parts of the State in dry soil in shaded places. Found in open woods, thickets or along fence rows.

Flowers from June until late in September.

Tippecanoe (Cunningham); Putnam (MacDougal); Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Franklin (Meyncke); Gibson and Posey (Schneck); Daviess (Clements); Fayette (Hessler); Vigo (Blatchley); Steuben (Bradner).

MERTENSIA Roth.**M. VIRGINICA (L.) DC. Smooth or True Lungwort. Blue-bells.**

In low, wet grounds and along streams, usually in rather shaded places. Common in most parts of the State, but especially abundant in the southern counties. Somewhat cultivated for ornament, but objectionable because of its rapid spread.

Flowers in March and April.

Cass and Fayette (Hessler); Jefferson (Barnes); Putnam (MacDougal); Clark (Baird and Taylor); Wayne (Phinney); Dearborn (Collins); Franklin (Meyncke); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Knox (Spillman); Vigo (Blatchley); Hamilton (Wilson).

MYOSOTIS L.**M. PALUSTRIS (L.) Lam. Forget-me-not.**

Added to the State flora by Mr. Blatchley. Growing in damp, low places and not at all abundant.

Flowers in May.

Vigo (Blatchley).

M. LAXA Lehm. Smaller Forget-me-not.

In wet, muddy places. Reported from Porter County by Rev. E. J. Hill.

Flowers from May until July.

M. VIRGINICA (L.) B. S. P. Spring Scorpion Grass.*(M. verna Nutt.)*

Confined to a few southern counties, where it is found on dry, rocky hillsides.

Flowers in April and May.

Clark (Baird and Taylor); Jefferson (J. M. Coulter); Franklin (Meyncke); Gibson and Posey (Schneck); Harrison.

LITHOSPERMUM L.

L. ARVENSE L. Corn Gromwell.

Indicative of dry, usually sandy soil. Found in many parts of the State, but especially abundant in the northern counties. It is found along railways, in waste places, sometimes taking possession of cultivated fields.

Flowers from May until late in August.

Tippecanoe (Cunningham); Cass and Fayette (Hessler); Jefferson (Barnes); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); St. Joseph (Rothert); Knox (Spillman); Vigo (Blatchley); Lake; Hamilton and Marion (Wilson); Steuben (Bradner).

L. OFFICINALE L. Gromwell.

Dry soil in fields and waste places. Common in the southern counties, not found in the northern.

Flowering from May until August.

Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyneke); Jefferson and Tippecanoe.

L. LATIFOLIUM Michx. American Gromwell.

In various parts of the State in dry soil in thickets or waste fields. Prefers sandy or gravelly soil and is more abundant in the northern counties.

Flowers in May and June.

Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Franklin (Meyneke); Gibson and Posey (Schneck); Fayette (Hessler); Vigo (Blatchley).

L. GMELINI (Michx.) A. S. Hitchcock. Hairy Puccoon.

(*L. hirtum* Lehm.)

Common in dry, sandy soil throughout the State. A conspicuous member of the flora of the dune region. Very abundant wherever found, but of more numerous stations in the northern part of the State.

Flowers from April through June.

Cass (Hessler); Laporte (Barnes); Vigo (Blatchley); Noble Van Gorder); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Tippecanoe (Noel); Knox (Spillman); Steuben (Bradner).

L. CANESCENS (Michx.) Lehm. Hoary Puccoon.

Dry, sandy soils on prairies and along roadsides or railways. Especially abundant in the northern counties.

Tippecanoe (Cunningham); Daviess (Clements); Vigo (Blatchley); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); St. Joseph (Rothert); Knox (Spillman).

L. ANGUSTIFOLIUM Michx. Narrow-leaved Puccoon.

In dry soil, especially on prairies or in open places. It prefers, as do the other species of the genus, sandy or gravelly, rather loose soil. According to reports, confined chiefly to the southern counties.

Flowering in May and June.

Vigo (Blatchley); Gibson and Posey (Schneck); Steuben (Bradner); Tippecanoe.

ONOSMODIUM Michx.**O. CAROLINIANUM (Lam.) DC. Shaggy False Gromwell.**

Confined for the most part to the southern counties, though found sparingly in the north-central parts. It frequents dry, gravelly soil and is generally found along roadsides or in waste fields.

Flowers in May and June.

Clark (Baird and Taylor); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Vigo (Blatchley); Tippecanoe (Cunningham); Hamilton (Wilson).

O. MOLLE Michx. Soft-hairy False Gromwell.

(*O. Carolinianum molle* Gray).

Open places in dry, sandy or rocky soil. Reported only south. Flowers May and June.

Clark (Baird and Taylor).

O. VIRGINIANUM (L.) DC.

Not common. Reported only from the eastern counties of the State as occurring on dry, rocky slopes.

Collected in flower in June.

Jay, Delaware, Randolph, and Wayne (Phinney).

SYMPHYTUM L.

S. OFFICINALE L. Comfrey. Healing Herb.

Rather common in southern counties, occurring in dry, waste places.

Flowers in June and July.

Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Marion; Monroe and Vigo (Blatchley).

ECHIUM L.

E. VULGARE L. Viper's Bugloss. Blueweed.

Somewhat sparingly found in the northern part of the State in coarse soils. It usually follows railroad embankments and is becoming more common within the past few years. Definite reports from but two counties.

Flowers in June and July.

Kosciusko (Hessler); Tippecanoe (Coulter).

VERBENACEÆ. Vervain Family.

VERBENA L.

V. OFFICINALIS L. European Vervain.

Rare in the southeastern part of the State, where its presence was noted by Dr. Robert Hessler as a migrant. It occurs in dry, coarse soil.

Collected in flower in June.

Fayette (Hessler); Jefferson.

V. URTICIFOLIA L. White or Nettle-leaved Verbena.

Common in most parts of the State in waste places, indicative of dry soil. A coarse, unsightly plant, hybridizing with several other species of the genus. According to Britton and Brown, it hybridizes with *V. bracteosa*, *V. hastata* and *V. stricta*.

Flowers from June through September.

Tippecanoe (Cunningham); Jefferson and Kosciusko (Coulter); Daviess (Clements); Fayette (Hessler); Putnam (MacDougal); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

V. HASTATA L. Blue Wild Verbena.

In moist, grassy fields and in waste places in most parts of the State. More abundant and of better development in dry soils.

Flowers from June until in September.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Fayette (Hessler); Hamilton and Marion (Wilson); Vigo (Blatchley); Steuben (Bradner).

V. ANGUSTIFOLIA Michx. Narrow-leaved Wild Verbena.

In dry, light sandy soils and on high banks of streams. According to Dr. Hessler, especially common in "wind-blown sandy soils which barely cover the underlying limestone." Hybridizes with *V. stricta* and *V. bracteosa*.

Daviess (Clements); Cass (Hessler); Jefferson (Barnes).

V. STRICTA Vent. Mullen-leaved Verbena.

Quite abundant in several counties and probably occurring throughout the State. Hybridizes with *V. bracteosa*. Dry, waste places.

Flowers from June until October.

Tippecanoe (Cunningham); Daviess (Clements); Putnam (MacDougal); Kosciusko (Coulter); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner); Fayette (Hessler).

V. BRACTEOSA Michx. Large-bracted Verbena. Prostrate Verbena.

Widely distributed in the State and ordinarily quite abundant. It frequents dry, open places or exposed sand and gravel banks.

Flowers from May until September.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Fayette (Hessler); Hamilton and Marion (Wilson); Monroe and Vigo (Blatchley); Gibson.

V. CANADENSIS (L.) Britton. Large-flowered Verbena.

(*V. Aubletia* L.)

In dry soil in the southern part of the State.

Flowers from May until August.

Jefferson and Gibson.

LIPPIA L.

L. LANCEOLATA Michx. Fog-fruit.

In moist soils in low places throughout the State. Usually abundant in the stations in which it is found.

Flowers from early in June through August.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (J. M. Coulter); Fayette (Hessler); Decatur (Ballard); Putnam (MacDougal); Kosciusko (Coulter); Vigo (Blatchley); Hamilton and Marion (Wilson).

LABIATÆ. Mint Family.

TEUCRIUM L.

T. CANADENSE L. Wood Sage.

Widely distributed and abundant, occurring in moist, rich soils. Its favorite stations seem to be the banks of streams and borders of marshes.

Flowers from June until the early frosts.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Vermillion (Wright); Fayette (Hessler); Hamilton and Marion (Wilson); Vigo (Blatchley); Steuben (Bradner).

ISANTHUS Michx.

I. BRACHIATUS (L.) B. S. P. False Pennyroyal.

(*I. coeruleus* Michx.)

An inconspicuous form found in the southern counties in sandy soils, chiefly along the banks of streams. Rather common.

Flowering season, July and August.

Jefferson (Barnes); Union (MacDougal); Franklin (Meyncke); Clark (Baird and Taylor); Fayette (Hessler).

TRICHOSTEMA L.

T. DICHOTOMUM L. Bastard Pennyroyal. Blue Curls.

First detected by Dr. B. W. Evermann as a member of the State flora and reported by Professor Blatchley. It occurs sparingly in sandy soil on river banks.

Collected in flower in September.

No additional stations have been reported.

Vigo (Blatchley).

SCUTELLARIA L.

S. LATERIFLORA L. Mad-dog Skullcap.

In wet soils throughout the State. Especially abundant at borders of wet thickets and in the low lands surrounding marshes and lakes.

Flowers from July through September.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (J. M. Coulter); Putnam (MacDougal); Gibson and Posey (Schneck);

Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Knox (Spillman); Round Lake (Deam); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

S. SERRATA Andr. Showy Skullcap.

Reported from but few counties as occurring sparingly in damp woods. A very handsome species of easy recognition.

Flowers in June and July.

Gibson and Posey (Schneck).

S. INCANA Muhl. Downy Skullcap.

(*S. canescens* Nutt.)

Quite abundant in many parts of the State. It is usually found in moist soils, although it is reported by Mr. Blatchley as "frequent in dry, open woods" in Vigo County.

Flowers in June and July.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Vermillion (Wright); Vigo (Blatchley); Hamilton and Marion (Wilson); Fayette (Hessler).

S. CORDIFOLIA Muhl. Heart-leaved Skullcap.

(*S. versicolor* Nutt.)

In most parts of the State in moist, shaded localities, found most abundantly in thickets and woods. The plant in our area stands for rich soils.

Flowers in June and July.

Jefferson and Tippecanoe (Barnes); Putnam (MacDougal); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Noble (Van Gorder); Fayette (Hessler).

S. PILOSA Michx. Hairy Skullcap.

Reported from southern part of the State as occurring in dry, sandy or rocky soil. Not common.

Flowers in May and June.

Putnam (MacDougal); Clark (Baird and Taylor); Dearborn (Collins); "Knobs" (Clapp).

S. PILOSA HIRSUTA (Short) Gray.

In similar situations. Plant stouter, and with larger, coarsely crenate leaves. Reported from but one county.

Flowers in June and July.

Putnam (MacDougal).

S. PARVULA Michx. Small Skullcap.

An early blooming form found in a few counties in moist, sandy soil.

Flowers from April until June.

Tippecanoe (Cunningham); Gibson and Posey (Schneck); Clark (Baird and Taylor); Crawford (Barnes); Monroe (Hessler).

S. GALERICULATA L. Marsh Skullcap.

In swamps and very wet soils. Extremely abundant in many of its northern stations. Found throughout the State.

Flowers in July and August.

Tippecanoe (Cunningham); Cass (Hessler); Laporte (Barnes); Noble (Van Gorder); Clark (Baird and Taylor); Lake (Hill); Round Lake (Deam); Kosciusko (Coulter); Marion; Steuben (Bradner).

S. NERVOSA Pursh. Veined Skullcap.

In damp, shaded places in rich soils throughout the State. Its favorite stations are heavy thickets and dense woods.

Flowers from May through the summer.

Daviess (Clements); Monroe and Vigo (Blatchley); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Floyd (Clapp); Marion (Wilson).

MARRUBIUM L.

M. VULGARE L. White Hoarhound.

In the southern and central parts of the State, not reported from north of Tippecanoe. In waste places and fields in rather dry soil.

Flowering begins in June and continues until the heavy frosts.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Franklin (Meyneke); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Gibson and Posey (Schneck); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

AGASTACHE Clayt.

A. NEPETOIDES (L.) Kuntze. Giant Hyssop. Giant Catnip.

(Lophanthus nepetoides Benth.)

In shaded, moist places in many counties. Its greater abundance is found in the southern counties.

Flowers from July until September.

Franklin (Meyncke); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Gibson and Posey (Schneck); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

A. SCROPHULARIAEFOLIA (Willd.) Kuntze. Figwort Giant Hyssop.

(Lophanthus scrophulariaefolius Benth.)

Of wider distribution and greater abundance than the preceding. In dry, upland soils in shaded places.

Flowers from July until the frosts.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Putnam (MacDougal); Gibson and Posey (Schneck); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler); Vigo (Blatchley).

A. ANETHIODORA (Nutt.) Britton. Fragrant Giant Hyssop.

(Lophanthus anisatus Benth.)

A western form which has obtained a lodgment in the eastern and southern part of the State. Found in dry, open places.

Flowers in July and August.

Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor).

NEPETA L.

N. CATARIA L. Catnip. Catmint.

Abundant in all parts of the State in waste places in rather dry soil. Best development is found where there is light shade. Perhaps the most commonly recognized member of our flora.

Flowers from July until the heaviest frosts.

Tippecanoe (Cunningham); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Jefferson (J. M. Coulter); Noble (Van Gorder); Clark (Baird and Taylor); Dearborn (Collins); Gibson and Posey (Schneck); Vermillion (Wright); Fayette (Hessler); Decatur and Shelby (Ballard); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

GLECOMA L.

G. HEDERACEA L. Ground Ivy. Wild Myrtle. Gill-over-the-Ground.
(*Nepeta Glechoma* Benth.)

Abundant and widely distributed. Found in moist soils, frequently driving out all other forms.

Flowers in March, continuing through May, though occasional flowers may be found until September.

Tippecanoe (Cunningham); Daviess (Clements); Fayette (Hessler); Monroe and Vigo (Blatchley); Jefferson (Barnes); Putnam (MacDougal); Franklin (Meyncke); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Dearborn (Collins); Gibson and Posey (Schneck); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

BRUNELLA L.

B. VULGARIS L. Heal-all. Selfheal. Blue Curls.
(*Brunella vulgaris* L.)

Abundant in various situations, but reaching its highest development in dry soils. Found, however, largely in low, damp grounds.

Flowers from May until late in the fall.

Tippecanoe (Cunningham); Daviess (Clements); Carroll and Jefferson (J. M. Coulter); Putnam (MacDougal); Gibson and Posey (Schneck); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Noble (Van Gorder); Fayette (Hessler); Monroe and Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

PHYSOSTEGIA Benth.

P. VIRGINIANA (L.) Benth. False Dragonhead.

Of general occurrence in all parts of the State. Found in greatest profusion and highest development in low, damp soils. The purple corolla is often variegated with white.

Flowering season begins in July and continues through September.

Tippecanoe (Cunningham); Cass and Fayette (Hessler); Jefferson and Jasper (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Dearborn (Collins); Owen (MacDougal); Daviess (Clement); Monroe and Vigo (Blatchley); Hamilton and Marion (Wilson).

SYNANDRA Nutt.

S. HISPIDULA (Michx.) Britton.

(S. grandiflora Nutt.)

One of the handsomest Labiates in our territory. It is confined to the southern part of the State and is nowhere abundant. Found in rich, damp soils in shaded places.

Flowering in May and June.

Vigo, Monroe, and Putnam (Blatchley); Jefferson (J. M. Coulter); Franklin (Meyncke); Wayne (Phinney); Hamilton (Wilson).

GALEOPSIS L.

G. TETRAHIT L. Hemp-Nettle.

Admitted to the flora upon the authority of the State Catalogue of Coulter and Barnes. It is probably found in many parts of the State, but I have not seen an Indiana collection nor has report of its occurrence been made to me. Dry soils in abandoned fields.

Marion and Jefferson.

LEONURUS L.

L. CARDIACA L. Motherwort.

Common in waste places and along fence rows in dry soils.

Flowers from June until September.

Tippecanoe (Cunningham); Hamilton and Marion (Wilson); Jefferson (Barnes); Putnam (MacDougal); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Gibson and Posey (Schneck); Fayette (Hessler); Steuben (Bradner); Vigo (Blatchley).

LAMIUM L.

L. AMPLEXICAULE L. Henbit.

In various counties of the State, but never abundant. Usually found along the edges of gardens or in fields but recently abandoned.

Its flowering season begins in February and continues until October.

Daviess (Clements); Jefferson (Barnes); Franklin (Meyncke); Noble (Van Gorder); Dearborn (Collins); Clark (Baird and Taylor); Putnam (MacDougal); Fayette (Hessler).

L. PURPUREUM L. Red Dead Nettle.

In waste and cultivated soils.

Flowers from April until October.

Steuben (Bradner).

STACHYS L.**S. HYSSOPIFOLIA Michx. Hyssop Hedge Nettle.**

In moist, shaded locations in the northern counties of the State.

Flowering season, July and August.

Laporte (Barnes); Lake (Hill); Marion.

S. TENUIFOLIA Willd. Smooth Hedge Nettle.

(*S. aspera glabra* Gray.)

In damp fields and thickets, chiefly in the southern counties. Not abundant.

Flowers in June and July.

Gibson and Posey (Schneck); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Vigo (Blatchley).

S. PALUSTRIS L. Common Hedge Nettle.

Widely distributed and abundant, occurring in moist soils. Locally known as Rough-weed.

Flowering from June until September.

Tippecanoe (Cunningham); Franklin (Meyncke); Clark (Baird and Taylor); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Kosciusko (Chipman); Knox (Spillman); Fayette (Hessler); Putnam (MacDougal); Hamilton and Marion (Wilson).

S. ASPERA Michx. Rough Hedge Nettle.

In moist soil, very frequent along streams and canals and on the borders of lakes. Of general distribution in the State.

Flowers from June through August.

Tippecanoe (Cunningham); Jefferson (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

S. CORDATA Riddell. Light-green Hedge Nettle.

In very damp shaded places. Widely distributed but not found in especial abundance at any of its stations.

Flowers in July and August.

Vigo (Blatchley); Jefferson (Barnes); Putnam (MacDougal); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Gibson and Posey (Schneck); Fayette (Hessler).

SALVIA L.**S. LYRATA** L. Lyre-leaved Sage.

In dry, sandy soil in thickets or light woods. Found only in a few counties.

Flowers from May through July.

Crawford (Blatchley); Jefferson (Barnes); Marion and Clark.

MONARDA L.**M. DIDYMA** L. Oswego Tea. Bee Balm.

Sparingly found in a few counties, occurring in moist soils along streams and in partially drained swamps.

Flowers in July and August.

Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck).

M. FISTULOSA L. Horsemint. Wild Bergamot.

Found under various soil and moisture conditions, but most frequent in dry sand or gravel soils. It also occurs largely in our area in recently drained lowlands. Very abundant in all parts of the State and easily recognized by its strong, rather unpleasant odor.

Flowers from June through August.

Tippecanoe (Cunningham); Daviess (Clements); Monroe and Vigo (Blatchley); Putnam (MacDougal); Jefferson (Barnes); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Dearborn (Collins); Round Lake (Deam); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

M. SCABRA Beck. Pale Horsemint.*(M. fistulosa mollis Benth.)*

This western form is reported by Mr. Blatchley as being found along the Vandalia railway at a single locality near Terre Haute.

Collected in flower in July.

Vigo (Blatchley).

M. BRADBURIANA Beck.

This species, which is rather southern and western in its general range, is found in many of the central and southern counties. It is found on dry slopes and in thin-soiled thickets.

Flowers from May through July.

Putnam (MacDougal); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Gibson and Posey (Schneck).

M. PUNCTATA L. Spotted Horsemint.

Less frequent than *M. fistulosa*, with which it is frequently associated. Occurs in dry soils in exposed places.

Flowers from July until October.

Laporte (Barnes); Noble (Van Gorder); Marion and southward.

Very common in Jasper, Lake, Porter, and Starke counties. (W. S. B.)

BLEPHILIA Raf.**B. CILIATA (L.) Raf.**

Abundant throughout the State in dry soils. Frequents open woods and thickets.

Flowers from June through August.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Putnam (MacDougal); Monroe and Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Gibson and Posey (Schneck); Hamilton (Wilson); Fayette (Hessler).

B. HIRSUTA (Pursh) Torr.

In similar locations as the preceding and very abundant in all parts of the State.

Flowers from June through August.

Jefferson (Barnes); Putnam (MacDougal); Noble (Van Gorder); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Clark (Baird and Taylor); Daviess (Clements); Vermillion (Wright); Tippecanoe (Cunningham); Fayette (Hessler); Marion and Hamilton (Wilson); Vigo (Blatchley); Steuben (Bradner).

HEDEOMA Pers.

H. PULEGIOIDES (L.) Pers. Pennyroyal.

Abundant in most parts of the State, growing in dry soils. It finds its best conditions in open woods or other light shaded places.

Flowers from June until October.

Tippecanoe (Cunningham); Jefferson (Barnes); Putnam (MacDougal); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

MELISSA L.

M. OFFICINALIS L. Garden Balm.

In the southern and eastern counties of the State, usually in the neighborhood of abandoned gardens or old dwellings. Thoroughly established.

Flowers in June and July.

Clark (Baird and Taylor); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler).

SATUREIA L.

S. HORTENSIS L. Savory. Summer Savory.

Escaped, in waste places.

Flowering season from July until September.

Gibson.

CLINOPODIUM L.

C. VULGARE L. Wild Basil. Basil-weed.

(*Calamintha Clinopodium* Benth.)

Confined to the counties fronting the Ohio River, and there found but sparingly.

Flowering from June through September.

Clark (Baird and Taylor); Jefferson (J. M. Coulter).

C. NEPETA (L.) Kuntze. Field Balm.

(*Calamintha Nepeta* Link and Hoffmang.)

Only in southeastern part of State, growing in woods. Only occasional.

Flowering in July in our area.

Franklin (Meyncke).

C. GLABRUM (Nutt.) Kuntze.*(Calamintha Nuttallii Benth.)*

In various counties, chiefly northern and eastern. Most often found on wet limestone cliffs or in moist sands.

Flowering season, from May until August.

Jay, Delaware, Randolph and Wayne (Phinney); Cass (Hessler); Lake (Hill).

C. GLABELLUM (Michx.) Kuntze.*(Calamintha glabella Benth.)*

Occasional along the banks of streams in a few counties. The form evidently entered our flora from the south, and is probably to be found in most of the counties adjoining the Ohio River.

Flowering in June.

Clark (Baird and Taylor): Jay, Delaware, Randolph, and Wayne (Phinney).

KOELLIA Moench.**K. FLEXUOSA (Walt.) MacM. Narrow-leaved Mountain-mint.***(Pycnanthemum linifolium Pursh.)*

In dry, sandy soil about streams and lakes. Common in the northern counties of its range, less frequent in the southern.

Flowering from July until September.

Cass (Hessler); Vigo (Blatchley); Gibson and Posey (Schneck); Franklin (Meynckel); Clark (Baird and Taylor); Lake (Hill).

K. VIRGINIANA (L.) MacM. Mountain-mint.*(Pycnanthemum lanceolatum Pursh.)*

Widely distributed through the State and extremely abundant in many localities. It grows in dry, sandy soil in prairies or woods, and is especially abundant in the sandy loams back from the margins of the smaller lakes. In these localities it frequently pushes its way far down into the low bottom lands.

Flowers in July and August.

Tippecanoe (Cunningham); Daviess (Clements); Cass (Hessler); Owen and Putnam (MacDougal); Clark (Baird and Taylor); Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Noble (Van Gorder); Gibson and Posey (Schneck); Hamilton (Wilson); Steuben (Bradner).

K. PILOSA (Nutt.) Britton. Hairy Mountain-mint.*(Pycnanthemum muticum pilosum Gray.)*

Only in southern counties, but there quite frequent on sandy hillsides and prairies.

Flowers July and August.

Gibson and Posey (Schneck); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

K. OLINOPODIOIDES (T. and G.) Kuntze.*(Pycnanthemum clinopodioides T. and G.)*

Reported only from southern Indiana, where it occurs in dry, rocky soil.

Collected in flower in August.

Clark (Baird and Taylor).

K. INCANA (L.) Kuntze. Hoary Mountain-mint.*(Pycnanthemum incanum Michx.)*

Confined to the southern counties, but there occurring in relative abundance in dry thickets or upon sandy slopes.

Flowers in August and September.

Monroe (Blatchley); Gibson and Posey (Schneck); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Daviess (Clements).

K. MUTICA (Michx.) Britton.*(Pycnanthemum muticum Pers.)*

A southern form, which, in common with many others from the same region, has obtained a foothold in the extreme southwestern counties of the State. It is found in sandy soil.

Flowers in July and August.

Gibson and Posey (Schneck).

CUNILA L.

C. ORIGANOIDES (L.) Britton. Sweet Horse-mint.*(C. Mariana L.)*

In the southern part of the State in dry, shaded locations. A not uncommon plant, easily recognized by its very aromatic odor.

Flowers in August and September.

Monroe (Blatchley); Johnson (Barnes); Clark (Baird and Taylor); Gibson and Posey (Schneck).

LYCOPIUS L.

L. VIRGINICUS L. Bugle-wood.

COMMON in extremely wet soil in many counties. More plentiful in the southern part of its range.

Flowers from late in June through September.

Gibson and Posey (Schneck); Clark (Baird and Taylor); Noble (Van Gorder); Fayette (Hessler); Vigo (Blatchley); Hamilton (Wilson).

L. RUTHELLI Moench. Water Hoarhound.

Rather plentiful in wet soils in various parts of the State.

Flowering from July until October.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (J. M. Coulter); Shriner Lake (Dean); Steuben (Bradner).

L. AMERICANUS Muhl. Cut-leaved Water Hoarhound.

(*L. sinuatus* Ell.)

Well distributed through the State and frequent along streams and ditches and about the margins of lakes.

Flowers from June until the frosts.

Putnam (MacDougal); Jay, Delaware, Randolph and Wayne (Phinney); Clark (Baird and Taylor); Gibson and Posey (Schneck); Vigo (Blatchley); Kosciusko (Coulter); Johnson.

L. EUROPEUS L. Water Hoarhound.

Reported from a single locality in southeastern Indiana by Dr. Robert Hessler. The general range is well to the east of Indiana. I have not seen Dr. Hessler's specimens, but admit the species to the list upon his collection.

Flowering September and October.

Fayette (Hessler); Hamilton (Wilson).

MENTHA L.

M. SPICATA L. Spearmint.

(*M. viridis* L.)

Common throughout the State in low, wet places.

Flowering from July until October.

Tippecanoe (Cunningham); Jefferson (Barnes); Union (MacDougal); Jay, Delaware, Randolph and Wayne (Phinney); Franklin (Meyncke); Clark (Baird and Taylor); Gibson and Posey (Schneck); Noble (Van Gorder); Dearborn (Collins); Daviess (Clements); Fayette (Hessler); Vigo (Blatchley); Steuben (Bradner).

M. PIPERITA L. Peppermint.

Borders of streams and in wet places throughout the State. Abundant in all suitable locations.

Flowers from July through September.

Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Clark (Baird and Taylor); Noble (Van Gorder); Gibson and Posey (Schneck); Vermillion (Wright); Decatur and Shelby (Ballard); Round Lake (Deam); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

M. ARVENSIS L. Field Mint.

In a few parts of the State in dry fields and waste places. Known locally as "wild pennyroyal."

Flowers in July and August.

Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney).

M. SATIVA L. Marsh-whorled Mint.

Confined to a few counties bordering the Ohio River, where it is sparingly found in dry, waste places.

Flowers in July and August.

Jefferson (J. M. Coulter); Clark (Baird and Taylor).

M. CANADENSIS L. Wild Mint.

Of general distribution throughout the State. Found in moist soils and especially abundant about springs and shallow streams.

Flowers from July until October.

Laporte (Barnes); Carroll and Jefferson (J. M. Coulter); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Dearborn (Collins); Tippecanoe (King); Fayette (Hessler); Vigo (Blatchley); Steuben (Bradner).

COLLINSONIA L.**C. CANADENSIS L. Horse-balm.**

In moist, rich woods in many counties. More plentiful in southern part of State.

Flowers from July through October.

Jefferson (Barnes); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Clark (Baird and Taylor); Gibson and Posey (Schneck); Noble (Van Gorder); Dearborn (Collins); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

SOLANACEÆ. Potato Family.

PHYSALODES Boehm.

P. PHYSALODES (L.) Britton. Apple of Peru.

(Nicandra physalodes Gaertn.)

In waste places in some southern counties. Somewhat common, but never far removed from abandoned gardens or house yards. Well established. The plant has the appearance of a large ground-cherry, with the leaves of the Jimson weed.

Flowers in July and August.

Gibson and Posey (Schneck); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Franklin (Meyncke); Fayette (Hessler); Hamilton and Marion (Wilson).

PHYSALIS L.

P. PUBESCENS L. Low, Hairy Ground Cherry.

Common in waste grounds, preferring sandy soil. Widely distributed throughout the State.

Flowers from July until October.

Tippecanoe (Cunningham); Daviess (Clements); Gibson and Posey (Schneck); St. Joseph (Barnes); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Vigo (Blatchley); Noble (Van Gorder); Jefferson (J. M. Coulter); Putnam (MacDougal); Vermillion (Wright); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

P. PRUNOSA L. Tall, Hairy Ground Cherry.

Reported from a single station as growing near a railroad. Certainly not of general occurrence.

Flowering in July and August.

Marion and Hamilton (Wilson).

P. ANGULATA L. Cut-leaved Ground Cherry.

A form growing in rich soil, in general found to the south and west of Indiana. It has been found in the central parts of the State, but has not been reported in the last ten years. Probably a migrant.

Marion.

P. PHILADELPHICA Lam.

Found as a rule at the edges of gardens or cultivated fields. It occurs in loose, rich soil, and while found in many counties, is nowhere abundant. Formerly cultivated for its fruit.

Flowers from July until October.

Daviess (Clements); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Noble (Van Gorder); Putnam (MacDougal); Decatur and Shelby (Ballard); Vigo (Blatchley); Hamilton and Marion (Wilson).

P. LANCEOLATA Michx. Prairie Ground Cherry.

In dry soil in open places or along the higher banks of streams. Found usually in fair abundance in any station which it occupies.

Flowers in July and August.

Gibson and Posey (Schneck); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Vigo (Blatchley); Kosciusko (Chipman); Marion.

P. VIRGINIANA Mill.

Common in loose, sandy soil in the southern counties. Extremely variable in our range.

Flowers from July through September.

Vigo (Blatchley); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Gibson and Posey (Schneck).

P. HETEROPHYLLA AMBIGUA (A. Gray) Rydberg.

Reported from a single station in southern Indiana. It grows in rich soil, especially that recently tilled, and is probably of frequent occurrence in the State.

Knox (Spillman).

P. VISCOSA L.

Reported from a number of counties, but always as "scarce" or "rare." The species is of the seashore, and I am inclined to refer plants so labelled to *P. heterophylla*. Admitted tentatively.

Flowering from June until September.

Jefferson (Barnes); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler); Decatur (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

SOLANUM L.

S. NIGRUM L. Black or Garden Nightshade.

Common throughout the State, in shaded waste places. Often found close to walls. Never widely spreading.

Flowers from July through October.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Carroll (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Dearborn (Collins); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Putnam (MacDougal); Decatur and Shelby (Ballard); Steuben (Bradner); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson).

S. CAROLINENSE L. Horse Nettle.

In dry fields, waste places and by roadsides. An annoying weed in the southern counties becoming less common in the northern. It prefers soils with considerable admixture of sand. Locally known as "Tread-soft" by the negroes in the southern counties.

Flowers from May until September.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Noble (Van Gorder); Vigo (Blatchley); Putnam (MacDougal); Vermillion (Wright); Decatur and Shelby (Ballard); Montgomery; Hamilton and Marion (Wilson); Fayette (Hessler).

S. ROSTRATUM Dunal. Sand Bur. Prickly Potato. Texas Nettle.

This species undoubtedly entered the State as a migrant, coming from the West. It was noted in Lake County in 1887, and in Vigo in 1888. As the species is included in all lists of the "worst weeds of the United States," it was feared that it would soon become troublesome. Since that time but few new stations have been reported, and where established the plant does not spread rapidly. Prefers sandy soils in open places.

Prefers sandy soils in open places.

Flowers from May through September.

Vigo (Blatchley); Lake (Hill); Madison (Walker); Marion (Hessler); Sullivan (Blatchley); Porter (Hill); Montgomery.

S. HETERODOXUM Dunal. Melon-leaved Nightshade.

An undoubted migrant which does not seem to have spread from the single station in which it was found. Its range as reported is west of the Mississippi River. Added to the flora by Dr. Hessler.

Monroe.

S. DULCAMARA L. Nightshade. Bittersweet. Poison Nightshade.

Chiefly southern in its distribution in the State, growing in moist shaded places. Found frequently at the edges of gardens and near brick walls. Locally it is thought that the leaves of this species are a virulent skin poison producing results as serious as in the case of poisoning from *Rhus radicans*. Repeated experiments upon myself and pupils failed to verify this opinion.

Flowering from May until late in September.

Jefferson (Barnes); Gibson and Posey (Schneck); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Marion; Kosciusko (Chipman); Steuben (Bradner).

LYCIUM L.**L. VULGARE (Ait. f.) Dunal. Matrimony Vine.**

Somewhat largely escaped and in places becoming troublesome. It fails to establish itself in the northern part of the State, but in the southern it spreads rapidly. Generally found in thickets and waste places.

Flowers from May through August.

Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Steuben (Bradner).

DATURA L.**D. STRAMONIUM L. Jamestown or Jimson-weed. Thorn Apple.**

In fields and waste places, growing especially rankly in old barnyards or in other rich soils. Common wherever found.

Flowers from June through September.

Steuben (Bradner); Tippecanoe (Cunningham); Daviess (Clements); Gibson and Posey (Schneck); Clark (Baird and Taylor); Dearborn (Collins); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Jefferson (J. M. Coulter); Putnam (MacDougal); Decatur and Shelby (Ballard); Fayette (Hessler); Hamilton and Marion (Wilson); Vigo (Blatchley).

D. TATULA L. Purple-stemmed Jimson.

More common than the preceding with which it is generally associated and from which it is not popularly separated. Soil and flowering habits as the preceding species.

Tippecanoe (Cunningham); Daviess (Clements); Clark (Baird and Taylor); Putnam (MacDougal); Gibson and Posey (Schneck); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Jefferson (J. M. Coulter); Vermillion (Wright); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson).

SCROPHULARIACEÆ. Figwort Family.**VERBASCUM L.****V. THAPSUS L. Common Mullein. Velvet Plant.**

Widely spread through the State and usually abundant, but never becoming a troublesome weed. It is found in dry, rather loose soils, growing in exposed places. It occasionally takes almost entire possession of abandoned fields. An infusion of the roots is often used as a household remedy for malaria.

Flowers from June until the frosts.

Tippecanoe (Cunningham); Putnam (MacDougal); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke); Dearborn (Collins); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Decatur and Shelby (Ballard); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

V. BLATTARIA L. Moth Mullein.

Widely distributed throughout the State, but much less common than the preceding. It is found in similar locations. The plant is said to repel the cockroach. It is much frequented by moths from which fact comes the popular name.

Flowers from June through September.

Tippecanoe (Cunningham); Vigo (Blatchley); Daviess (Clements); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Dearborn (Collins); Jennings (Barnes); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner); Fayette (Hessler).

LINARIA Juss.

L. LINARIA (L.) Karst. Butter and Eggs. Toad-Flax.
(*L. vulgaris* Mill.)

Abundant in waste places and along roadsides in most parts of the State. Not difficult to eradicate.

Flowers from June until September.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (J. M. Coulter); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Dearborn (Collins); Decatur and Shelby (Ballard); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

L. CANADENSIS (L.) Dumont. Blue Toad Flax.

Found only in extreme northern part of the State in dry sandy soil.

Lake.

ANTIRRHINUM L.

A. MAJUS L. Great Snap-dragon.

Escaped from cultivation and well established in a few southern counties.

Flowers from June through August.

Gibson and Posey (Schneck); Clark (Baird and Taylor); Jefferson.

SCROPHULARIA L.

S. MARYLANDICA L. Pilewort. Heal-all.

(*S. nodosa Marylandica* Gray.)

Throughout the State in damp woods and thickets, preferring rich, muck or loam soils. While found in all parts of the State, it rarely occurs in great number in any single station.

Flowers from July through September.

Tippecanoe (Cunningham); Daviess (Clements); Putnam (MacDougal); Carroll (J. M. Coulter); Clark (Baird and Taylor); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Jefferson (J. M. Coulter); Dearborn (Collins); Decatur (Ballard); St. Joseph (Rothert); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

CHELONE L.

C. GLABRA L. Snake-head. Turtle-head.

In marshes and low, wet grounds chiefly in the northern part of the State, though sparingly found as far south as Vigo County.

Flowers from July until September.

Tippecanoe (Cunningham); Cass and Fayette (Hessler); Jefferson (J. M. Coulter); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Decatur (Ballard); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

C. OBLIQUA L. Red Turtle-head.

Reported from but few counties in the State. It is found in wet thickets and along streams or by the shores of lakes.

Flowers in July and August.

Gibson (Schneck); Hamilton and Marion (Wilson); Putnam (MacDougal).

PENTSTEMON Soland.

P. HIRSUTUS (L.) Willd. Hairy Beard-tongue.

(*P. pubescens* Soland.)

In dry woods and thickets, on the borders of prairies and on sandy or gravelly banks. Preferring soil heavily mixed with sand or gravel. Found throughout the State.

Flowers from May through July.

Daviess (Clements); Cass (Hessler); Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyneke); Clark (Baird and Taylor); St. Joseph (Rothert); Hamilton (Wilson); Steuben (Bradner).

P. DIGITALIS (Sweet) Nutt. Foxglove.

(*P. laevigatus Digitalis* Gray.)

Found chiefly in the southern part of the State in rich, moist soil, usually in thickets or open woods. Not reported to occur north of Jay County.

Flowers in May and June.

Gibson and Posey (Schneck); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Jennings (Barnes); Daviess (Clements); Hamilton and Marion (Wilson).

P. PENTSTEMON (L.) Britton. Smooth Beard-tongue.
(*P. laevigatus* Soland.)

Common in moist woods and thickets in the southern counties, sparingly found in drift soils farther north. Not reported north of Cass County.

Flowers from May until July.

Daviess (Clements); Cass and Fayette (Hessler); Jefferson (J. M. Coulter); Jennings (Barnes); Vigo (Blatchley); Putnam (MacDougall); Clark (Baird and Taylor); Knox (Spillman); Marion.

COLLINSIA Nutt.

C. VERNA Nutt. Blue-eyed Mary. Innocence.

In moist, shaded places in many counties, being much more common in the southern counties. The species is found sparingly, however, throughout the northern counties. Easily recognized by the differing colors of its upper and lower lips. One of the most attractive of our early flowers.

Flowers from April until June.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Dearborn (Collins); Knox (Spillman); Tippecanoe (Coulter); Hamilton (Wilson); Steuben (Bradner).

MIMULUS L.

M. RINGENS L. Square-stemmed Monkey flower.

In swamps and along the low banks of streams and lakes, preferring loam soil. Where sand cuts down through the loam, the species rapidly disappears. Widely distributed.

Flowers from June until September.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Vigo (Blatchley); Putnam (MacDougall); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Clark (Baird and Taylor); Vermillion (Wright); Fayette (Hessler); Steuben (Bradner).

M. ALATUS Soland. Sharp-winged Monkey-flower.

In locations similar to the preceding and of equally wide distribution. It is the prevailing form in the northern part of the State.

Flowers from June through September.

Tippecanoe (Cunningham); Daviess (Clements); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson).

CONOBEA Aubl.**C. MULTIFIDA (Michx.) Benth.**

Along streams and on borders of ponds in sandy or gravelly soil. Well distributed through the State, but more abundant in southern counties.

Flowers from June through August.

Tippecanoe (Cunningham); Jefferson and Clark (Barnes); Vigo (Blatchley); Gibson and Posey (Schneck); Franklin (Meyncke); Daviess (Clements); Putnam (MacDougal); Fayette (Hessler).

GRATIOLA L.**G. VIRGINIANA L. Clammy Hedge Hyssop.**

In very damp soils along streams and ditches and by the borders of lakes and ponds. Confined to the southern part of the State for the most part, though found exceptionally northward.

Flowers from May until the early frosts.

Gibson and Posey (Schneck); Steuben (Bradner); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (VanGorder); Franklin (Meyncke); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Vigo (Blatchley); Hamilton and Marion (Wilson).

G. SPHAEROCARPA Ell.

In low, wet places in the southern counties of the State, but nowhere abundant.

Flowers from June through August.

Vigo (Blatchley); Franklin (Meyncke); Monroe (Blatchley).

G. VISCOSA Schwein. Viscid Hedge Hyssop.

A southern form reported from a single county. Specimens so referred are in the DePauw herbarium. I have examined the specimens, and am inclined to believe they are correctly referred.

Collected in flower in June.

Putnam (MacDougal).

ILYSANTHES Raf.

I. GRATIOLOIDES (L.) Benth. False Pimpernel.

(*I. riparia* Raf.)

Widely distributed, growing in the rich, muck soils of the banks of rivers and lakes.

Flowers from July through August.

Tippecanoe (Cunningham); Clark and Jefferson (Barnes); Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyneke); Carroll (J. M. Coulter); Hamilton and Marion (Wilson); Fayette (Hessler); Steuben (Bradner).

WULFENIA Jacq.

W. HOUGHTONIANA (Benth.) Greene.

(*Synthyris Houghtoniana* Benth.)

In dry, sandy soils in the northern half of the State, though found sparingly as far south as Vigo County.

Flowers in June.

Vigo (Blatchley); Tippecanoe (Wright); Kosciusko (Coulter); Noble (Van Gorder); Elkhart (Barnes); Lake.

VERONICA L.

V. ANAGALLIS-AQUATICA L. Water Speedwell.

In swamps and rather slow running, shallow streams. Fairly distributed through the State, but much more abundant in the northern half.

Flowers from May through August.

Tippecanoe (Cunningham); Jay, Delaware, Randolph, and Wayne (Phinney); Cass and Fayette (Hessler); Union (MacDougal); Noble (Van Gorder); Jefferson (J. M. Coulter); Decatur (Ballard); Steuben (Bradner).

V. AMERICANA Schreb.

Found in similar locations as the preceding which it much resembles. Only occasionally found in the State Indiana being somewhat west of the general range of the species.

Flowers from April through August.

Tippecanoe (Hessop) ; Putnam (Meyneke) ; Jefferson (J. M. Cooper) .

V. CONVALLATA L. Siskitong Speedwell.

In marshes and swamps in several and numerous localities of the State. Not abundant.

Flowering season from May until late in September.

Tippecanoe (Cunningham) ; Noble (Van Gorder) ; Hamilton and Marion (Wilson) ; Starbuck (Brainer) .

V. OFFICINALIS L. Common Speedwell.

In dry fields and woods well distributed through the State, and probably of general occurrence with perhaps the exception of the extreme northern counties.

Flowers from May through August.

Jefferson (Barnes) ; Putnam (McDonough) ; Jay (Delaware, Randolph, and Wayne) (Phinney) ; Clark (Baird and Taylor) ; Hamilton and Marion (Wilson) ; Fayette (Hessler) ; Tippecanoe (Wright) ; Starbuck (Brainer) .

V. CHAMÆDYS L.

Reported only from the Purdue Campus. Probably a migrant brought in with packing materials or mixed with other seeds. The form maintained itself for a number of years, but has now disappeared.

Tippecanoe (Hessop) .

V. SERPYLLIFOLIA L. Thyme leaved Speedwell.

A common and widely distributed form occurring in fields and along roadsides.

Flowers from April until September.

Tippecanoe (Cunningham) ; Gibson and Posey (Schneck) ; Jefferson (Barnes) ; Putnam (McDonough) ; Jay (Delaware, Randolph, and Wayne) (Phinney) ; Noble (Van Gorder) ; Franklin (Meyneke) ; Clark (Baird and Taylor) ; Decatur (Ballard) ; Vigo (Blatchley) ; Hamilton and Marion (Wilson) .

V. PEREGRINA L. Purslane Speedwell.

Our most common form of the genus. Found in waste places and cultivated grounds, frequently invading lawns.

Flowers from May through September.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Clark (Baird and Taylor); Knox (Spillman); Decatur (Ballard); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson).

V ARVENSIS L. Corn Speedwell.

Usually in damp places, in many parts of the State. It multiplies more rapidly in tilled lands and sometimes becomes annoying in rich lawns.

Flowers from May until the frosts.

Putnam (MacDougal); Steuben (Bradner); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Knox (Spillman); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson).

V. AGRESTIS L. Garden Speedwell.

Upon authority of Dr. MacDougal, who reports it as found in Putnam County. The only record for the State.

LEPTANDRA Nutt.**L. VIRGINICA (L.) Nutt. Culver's-root.**

(*Veronica virginica* Nutt.)

Distributed throughout the State in rich, moist soils. Found most commonly in thickets and open woods, though also occurring in wet meadows.

Flowering from June until late in September.

Tippecanoe (Cunningham); Daviess (Clements); White (Hussey); Vigo (Blatchley); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Jefferson (J. M. Coulter); Hamilton (Wilson); Steuben (Bradner); Cass and Fayette (Hessler).

BUCHNERA L.

B. AMERICANA L. Blue-hearts.

In several widely separated counties, growing in dry, sandy or gravelly soil. Nowhere abundant.

Flowers from June through August.

Floyd, Harrison, and Lake.

AFZELIA J. G. Gmel.

A. MACROPHYLLA (Nutt.) Kuntze. Mullen Foxglove.

(*Seymeria macrophylla* Nutt.)

In rich, moist soils, along streams and in thickets. Confined to the central and southern counties in its mass distribution, though reported as far north as Montgomery County.

Flowers in August and September.

Vigo, Monroe, Montgomery, and Putnam (Blatchley); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Fayette (Hessler); Hamilton (Wilson).

DASYSTOMA Raf.

D. PEDICULARIA (L.) Benth. Fern-leaf Foxglove.

(*Gerardia pedicularia* L.)

In dry woods in the northern part of the State. Probably of limited distribution.

Flowering late in August and in September.

Elkhart (Barnes); Tippecanoe (Noel); Steuben (Bradner).

D. FLAVA (L.) Wood. Downy False Foxglove.

(*Gerardia flava* L.)

In the northern part of the State in considerable abundance in dry woods and thickets. Extending south sparingly as far as Vigo County.

Flowering in July and August.

St. Joseph (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Jefferson (J. M. Coulter); Vigo (Blatchley); Steuben (Bradner).

D. GRANDIFLORA (Benth.) Wood. Western False Foxglove.

(*Gerardia grandiflora* Benth.)

In dry woods and thickets in the northern part of State.

Flowers from July to August.

Steuben (Bradner).

D. VIRGINICA (L.) Britton. Oak-leaved False Foxglove.*(Gerardia quercifolia Pursh.)*

Quite abundant and of wide distribution in the State. Chiefly found in moist soils on shaded banks of streams or lake margins. Less frequently occurring in dry soil in open places. A very showy species in the flowering season.

Flowers from July until September.

Tippecanoe (Cunningham); Daviess (Clements); Johnson (Barnes); Jefferson (J. M. Coulter); Franklin (Meyncke); Gibson and Posey (Schneck); Vigo (Blatchley); Kosciusko (Coulter); Steuben (Bradner); Cass (Hessler).

GERARDIA L.**G. ASPERA Dougl. Rough Purple Gerardia.**

In the southwestern counties in dry prairies in rather heavy clay soil. Not abundant.

Flowers in August and September.

Gibson and Posey (Schneck).

G. PURPUREA L. Large Purple Gerardia.

Abundant and widely distributed in the State. Found in damp, open meadows and fields in rich soils. A very handsome species when in full flower.

Flowering season, August and September.

Tippecanoe (Cunningham); Daviess (Clements); Noble and Jefferson (Barnes); Lagrange (Blatchley); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Clark (Baird and Taylor); Knox (Spillman); Kosciusko (Chipman); Steuben (Bradner).

G. PAUPERCULA (Gray) Britton. Small-flowered Gerardia.

Reported from a single station in northern Indiana. It will probably be found to occur throughout the northern part of the inland lake region.

Collected in flower September 1.

Shriner Lake (Deam).

G. TENUIFOLIA Vahl. Slender Gerardia.

The most common of the Gerardias in the State. Found in many counties in abundance. It is found usually in dry soils on hills and in opens, but occasionally finds its way into damp places. Most luxuriant in our area in soil that is quite sandy.

Flowers from July through September.

Steuben (Bradner); Tippecanoe (Barnes); Jefferson (J. M. Coulter); Vigo (Blatchley); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyneke); Clark (Baird and Taylor); Daviess (Clements); Fayette (Hessler).

G. BESSEYANA Britton.

(*G. tenuifolia macrophylla* Benth.)

Admitted upon the authority of Dr. L. M. Underwood, who reports the species from Putnam County. The only record for the State.

Putnam (Underwood).

G. SKINNERIANA Wood.

Occasional in the central part of the State, growing in dry soil in shaded places.

Flowers from August through October.

Hamilton (Wilson).

G. AURICULATA Michx. Auricled *Gerardia*.

In moist, open soils in the northern part of the State. Reported definitely from but a single station.

Collected in flower in August.

Tippecanoe (Cunningham).

CASTILLEJA Mutis.

C. COCCINEA (L.) Spreng. Scarlet Painted-cup. Indian Paint-brush.

Found in widely separated counties in varying situations. In the northern counties it usually occurs in meadows and damp thickets. In the southern, Mr. Blatchley notes it as common in "virgin prairie soil" near Heckland in Vigo County. In the northern part of its range it is usually not far removed from lakes.

Flowers from May until in July.

Vigo (Blatchley); Gibson and Posey (Schneck); Noble (Van Gorder); Cass (Hessler); Knox (Spillman); St. Joseph (Rothert); Steuben (Bradner).

PEDICULARIS L.

P. LANCEOLATA Michx. Swamp Lousewort.

In swamps and very wet, rich soils throughout the State. Not uncommon in any part of its range.

Flowers from August through September.

Tippecanoe (Cunningham); Fayette and Cass (Hessler); Gibson and Posey (Schneck); Jay (Phinney); Noble (Van Gorder); Putnam (MacDougal); Vigo (Blatchley); Marion (Wilson); Steuben (Bradner).

P. CANADENSIS L. Common Lousewort.

Quite abundant in many parts of the State. Found in dry, shaded places, either woods or thickets, in rather sandy soils.

Flowers from April through June.

Tippecanoe (Cunningham); Jefferson (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Clark (Baird and Taylor); Putnam (MacDougal); Vigo (Blatchley); Steuben (Bradner).

MELAMPYRUM L.

M. LINEARE Lam. Narrow-leaved Cow-wheat.

(*M. Americanum Michx.*)

Found in the northern counties in dry woods and thickets.

Flowers from May until August.

Steuben (Bradner); Lake.

LENTIBULARIACEÆ. Bladderwort Family.

UTRICULARIA L.

U. CORNUTA Michx. Horned Bladderwort.

On borders of ponds or in bogs, in the northern counties.

Flowers from June to August.

Lake.

U. RESUPINATA B. D. Greene. Reversed Bladderwort.

In the sandy edges of lakes in the northern counties. Not uncommon.

Flowers from March until August.

Lake (Hill); Noble (Van Gorder); Round Lake (Deam).

U. PURPUREA Walt. **Purple Bladderwort.**

In shoal water of lakes and marshes in northern part of State.
Lake (Hill).

U. VULGARIS L. **Greater Bladderwort.**

Common in streams and ponds in the central and northern parts of the State.

Flowers in July and August.

Laporte (Barnes); Shriner Lake (Deam); Hamilton (Wilson); Kosciusko (Coulter); Steuben (Bradner); Cass (Hessler).

U. INTERMEDIA Hayne. **Flat-leaved Bladderwort.**

Throughout the State in shallow water along the margins of pools and ponds.

Flowers from June to August.

U. GIBBA L. **Humped Bladderwort.**

In the shallow water at the margins of lakes and pools, more frequently in mud. Added to the flora by Rev. E. J. Hill, whose labors have given us our chief knowledge of the aquatic and sand-dune flora of the State. Several stations were afterward added in Noble County by Mr. Van Gorder and in Steuben by Mr. Bradner.

Lake (Hill); Noble (Van Gorder); Kosciusko (Coulter); Steuben (Bradner).

OROBANCHACEÆ. Broom-rape Family.**THALESIA** Raf.**T. UNIFLORA** (L.) Britton. **One-flowered Broom-rape. Cancer-root.**

(*Aphyllon uniflorum* T. and G.)

Not frequent, but found in many counties of the State, parasitic on the roots of herbs.

Flowers in May and June.

Tippecanoe (Cunningham); Clark (Barnes); Vigo (Blatchley); Marion.

T. FASCICULATA (Nutt.) Britton. **Yellow Cancer-root.**

(*Aphyllon fasciculatum* Gray.)

In the northern part of the State, generally associated with plants of the dunes, where it is found as a root parasite on *Artemisia Canadensis* and *Artemisia caudata*.

Lake (Hill); Porter (Cowles).

OROBANCHE L.

O. LUDOVICIANA Nutt. Broom-rape.

(Aphyllon ludovicianum Gray.)

Banks of Wabash River, near brick yards above Terre Haute; frequent locally in 1889-90. Parasitic on the roots of the Great Horse-weed, *Ambrosia trifida* L. Added to the State flora by W. S. Blatchley.

CONOPHOLIS Wallr.

C. AMERICANA (L. f.) Wallr. Squaw-root.

Not uncommon in many parts of the State, being found in rich woods. It is more frequently associated with oaks in our area than with any other genus.

Flowers April to August.

Tippecanoe (Cunningham); Clark (Barnes); St. Joseph (Rothert); Putnam (MacDougal); Fayette (Hessler); Monroe and Vigo (Blatchley); Hamilton (Wilson); Steuben (Bradner); Jefferson.

LEPTAMNIUM Raf.

L. VIRGINIANUM (L.) Raf. Beech-drops.

(Epiphegus Virginiana L.)

Found in beech woods throughout the State. More abundant in dense woods. As the mass distribution of the beeches is in the southern part of the State, the species is there more abundant.

Flowering in August and September.

Jefferson and Laporte (Barnes); Putnam (MacDougal); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

BIGNONIACEÆ. Trumpet-creeper Family.

BIGNONIA L.

B. CAUCIGERA L. Tendrilled Trumpet-flower.

(B. capreolata L.)

In moist woods in southwestern Indiana.
Flowers from April until June.

TECOMA Juss.

T. RADICANS (L.) DC. Trumpet-flower. Trumpet-creeper.

In all parts of the State, in especial abundance and development southward. It grows either in moist, rich, alluvial soils or in sandy soils, being found as a constituent of the flora of the Basswood dunes. When brought in cultivation it multiplies with extreme rapidity. One of the most attractive of our climbing plants.

Flowers from June until August.

Cass (Hessler); Daviess (Clements); Dearborn (Collins); Putnam (MacDougal); Clark (Baird and Taylor); Franklin (Meynecke); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Decatur and Shelby (Ballard); Lake and Porter (Cowles); Vigo (Blatchley); Hamilton and Marion (Wilson).

CATALPA Scop.

C. CATALPA (L.) Karst. Catalpa. Indian Bean.

(*C. bignonioides* Walt.)

This southern form has escaped from cultivation in the southern counties of the State and is there well established. The wood is light and weak, but very durable in contact with the soil, making it valuable for posts.

Flowers in June and July.

Jefferson (Barnes); Clark (Baird and Taylor); Dearborn (Collins); Franklin (Meynecke); Gibson and Posey (Schneck).

C. SPECIOSA Warder. Catalpa. Larger Indian Bean.

This is the species under cultivation in most parts of the State, being largely used for ornamental and shade purposes. It has escaped to a greater or less extent in almost every section in which it has been largely cultivated. In some counties "catalpa groves" have established themselves in rather damp, rich soils. The wood is somewhat lighter in weight than in the preceding species, but equally durable in contact with the soil. The rapidity of growth of the catalpa suggests as suitable for planting for "posts" and other purposes in which durability in contact with the soil is desired.

Flowers in May and June.

Jay, Delaware, Randolph, and Wayne (Phinney); Vigo (Blatchley); Tippecanoe (Coulter).

MARTYNIACEÆ. Unicorn-plant Family.**MARTYNIA L.****M LOUISIANA Mill. Unicorn-plant. Elephant's Trunk.***(M. proboscidea* Glox.)

This interesting plant, said to be of carnivorous habit, is confined to the southern counties of the State. It is found rather sparingly in rich, loose sandy soil usually along the banks of streams.

Flowers in August and September.

Jefferson (Barnes); Franklin (Meyneke); Clark (Baird and Taylor); Gibson and Posey (Schneck); Vigo (Blatchley).

ACANTHACEÆ. Acanthus Family.**RUELLIA L.****R. STREPENS L. Smooth Ruellia.**

Indicative of rich soil, growing in moist shaded places. Well distributed throughout the State.

Flowers from May until July.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Fayette and Cass (Hessler); Putnam (MacDougal); Decatur (Ballard); Hamilton and Marion (Wilson); Vigo (Blatchley).

R. CILIOSA Pursh. Hairy Ruellia.

Found throughout the State in dry, sandy soil. More abundant than the preceding species.

Flowers from June through September.

Tippecanoe (Cunningham); Cass (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson).

DIANTHERA L.**D. AMERICANA L. Dense flowered Water Willow.**

Growing in shallow water at the edges of sandbars, or low banks of streams or at the margin of pools. Prefers a sandy soil. Abundant.

Flowers from May through August.

Tippecanoe (Cunningham); Jennings (Barnes); Jefferson (Coulter); Decatur and Shelby (Ballard); Putnam (MacDougal); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson).

PHRYMACEÆ. Lopseed Family.**PHRYMA L.****P. LEPTOSTACHYA L. Lopseed.**

Common in many parts of the State in moist, dense woods and thickets. Easily recognized by the calyx being abruptly reflexed against the spike after flowering.

Flowers from late in June through August.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (J. M. Coulter); Putnam (MacDougal); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

PLANTAGINACEÆ. Plantain Family.**PLANTAGO L.****P. MAJOR L. Common or Greater Plantain.**

Abundant throughout the State in waste places, frequently becoming an annoying weed in lawns and along brick walks. Very variable in leaf and spike. Commonly confused with the next species, which is perhaps the prevailing form in the northern counties.

Flowers from May until September.

Putnam (MacDougal); Dearborn (Collins); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyncke); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

P. RUGELII Decaisne. Rugel's Plantain.

Not separated as a rule from the preceding, although found in almost every collection from a northern county. The two species intergrade almost perfectly as to leaf and spike characters. They may, however, be readily separated by the size and number of the seeds. In *P. major* the capsule contains from eight to sixteen seeds, in *P. Rugelii* from four to nine, the seeds of the latter species being much the larger. The plants are found associated and have similar flowering seasons.

Tippecanoe (Cunningham); Jefferson (Barnes); Vigo (Blatchley).

P. LANCEOLATA L. Ribwort. Rib-grass. English Plantain.

Indicative of coarse, rather gravelly dry soils. Found throughout the State at borders of fields, in waste places and along railways. In some localities becoming an annoying weed.

Flowers from April until the heaviest frosts.

Tippecanoe (Cunningham); Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Noble (Van Gorder); Franklin (Meyneke); Hamilton and Marion (Wilson); Steuben (Bradner); Fayette (Hessler).

P. SPARSIFLORA Michx. Southern Plantain

Reported only from southern part of the State. I would be inclined to regard it as a depauperate form of *P. major* had it not been for the two-seeded pyxis. Reported also in southern Illinois.

Clark (Baird and Taylor).

P. CORDATA Lam. Water Plantain. Heart-leaved Plantain.

Of more common occurrence in State than reports would indicate. In marshes and along low banks of rather sluggish streams.

Flowers from March through July.

Tippecanoe (Cunningham); Gibson and Posey (Schneck); Kosciusko (Coulter).

P. ARISTATA Michx. Large-bracted Plantain.

(*P. Patagonica aristata* Gray.)

Not abundant, but found in several counties in dry, coarse soils, chiefly along railway embankments and roadsides.

Flowers from May until the frosts.

Vigo (Blatchley); Clark (Baird and Taylor); Dearborn (Collins); Hamilton (Wilson); Cass (Hessler).

P. VIRGINICA L. Dwarf or White Plantain.

Common in many parts of the State in dry soil in waste places. Flowers from the middle of March through June.

Tippecanoe (Cunningham); Clark (Barnes); Monroe and Vigo (Blatchley); Jefferson (J. M. Coulter); Franklin (Meyneke); Gibson and Posey (Schneck); Knox (Spillman); Fayette (Hessler).

P. ELONGATA Pursh. Slender Plantain.*(P. pusilla Nutt.)*

Reported only from Gibson County by Dr. Schneck as rare in dry, sandy soil.

Collected in flower in May.

Gibson (Schneck).

RUBIACEÆ. Madder Family.**HOUSTONIA L.****H. CÆRULEA L. Bluets. Innocence.**

Very abundant in the southern part of the State in grassy places and on damp rocks. It extends north in the State as far as Lake County. It is found in great profusion in favorable stations and is one of the prettiest of our spring forms.

Flowers from early in April until in July.

Cass (Hessler); Monroe and Putnam (MacDougal); Jefferson (Barnes); Clark (Baird and Taylor); Franklin (Meyncke); Dearborn (Collins); Vigo and Lake (Blatchley).

H. PURPUREA L. Large Houstonia.

Abundant in open places, especially sandy soils about lakes and in dry woods and thickets.

Flowers from April through June.

Jefferson (Barnes); Tippecanoe (Cunningham); Monroe (Blatchley); Gibson and Posey (Schneck); Putnam (MacDougal); Kosciusko (Coulter); Cass (Hessler); Marion (Wilson).

H. CILIOLATA Torr. Fringed Houstonia.

Confined to rocky hillsides in the southern part of the State and to sandy shores in the northern counties. Not especially abundant.

Flowers from May through July.

Jefferson (Barnes); Clark (Baird and Taylor); St. Joseph (Rothert); Vigo (Blatchley); Floyd (Barnes); Tippecanoe.

H. LONGIFOLIA Gaertn. Long-leaved Houstonia.*(H. purpurea longifolia Gray.)*

In central and eastern counties rather sparingly. In low grounds, usually in dry, sandy soil.

Flowers from May through September.

Monroe (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler).

CEPHALANTHUS L.

C. OCCIDENTALIS L. Button-Bush. Globe-flower.

An abundant shrub in all parts of the State, growing in marshes or low, wet ground. About some of the inland lakes it takes on an arborescent habit, reaching a height of 20 feet. A handsome and easily recognized species, well adapted for ornamental purposes where mass effects are desired.

Flowers from June through September.

Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Franklin (Meyncke); Gibson and Posey (Schneck); Putnam (MacDougal); Noble (Van Gorder); Shriner Lake (Deam); Hamilton and Marion (Wilson); Steuben (Bradner); Cass and Fayette (Hessler).

MITCHELLA L.

M. REPENS L. Partridge-berry. Twin-berry.

In woods usually associated with various mosses. A delicate trailing plant, quite abundant in the southern counties, but becoming scarce in the central and northern parts of the State.

Flowers from April until late in June.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Noble (Van Gorder); Putnam (MacDougal); Steuben (Bradner).

SPERMACOCE L.

S. GLABRA Michx. Smooth Button-weed.

Confined to the southern counties of the State, where it grows in very wet soil, chiefly along the banks of streams.

Flowering in July and August.

Daviess (Clements); Jefferson (Coulter); Clark (Baird and Taylor); Gibson and Posey (Schneck).

DIODIA L.

D. TERES Walt. Rough Button-weed.

In dry, sandy soil only in the extreme southern part of the State.

Flowering late in July and in August.

Gibson and Posey (Schneck); Crawford (Blatchley).

GALIUM L.

G. APARINE L. Cleavers. Catch-weed.

Abundant throughout the State in low, damp grounds, or in damp woods and ravines. In favorable locations makes its way over the plants of a wide area. Its greatest development is in rich alluvial soils at borders of marshes.

Flowers from May until September.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Decatur (Ballard); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Gibson and Posey (Schneck); Putnam (MacDougal); Kosciusko (Coulter); Knox (Spillman); St. Joseph (Rotherth); Hamilton and Marion (Wilson).

G. PILOSUM Ait. Hairy Bedstraw.

Found chiefly in the northern counties of the State in sand soils in dry locations. Only a single report from the south part of the State.

Flowers in July and August.

Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Lake; Steuben (Bradner).

G. LANCEOLATUM Torr.

Of sparing occurrence in the State. Confined to central and northern counties. Found growing in dry woods in loose, sandy soil.

Flowers in July and August.

Putnam (MacDougal); Noble (Van Gorder).

G. CIRÆZANS Michx. Wild Liquorice.

One of our most abundant forms, growing in rich soils, usually in woods or thickets. Found throughout the State.

Flowers in June and July.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Daviess (Clements); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Franklin (Meyncke); Putnam (MacDougal); Tippecanoe (Cunningham); Vermillion (Wright); Hamilton and Marion (Wilson); Steuben (Bradner).

G. BOREALE L. Northern Bedstraw.

Found in the northern counties of the State in marshes and wet places and on limestone ledges. In this latter situation the species extends as far south as Decatur County.

Flowers from June through August.

Kosciusko (Chipman); Cass and Marshall (Hessler); Noble (Van Gorder); Lake (Hill); St. Joseph (Rothert); Decatur (Ballard); Wabash (Jenkins).

G. TRIFLOBUM Michx. Sweet-scented Bedstraw.

Abundant, especially in the northern counties in rather dry woods and thickets. Much less common in the southern counties.

Flowers from late in May until August.

Fayette and Cass (Hessler); Franklin (Meyneke); Jefferson (J. M. Coulter); Marion, Monroe, and Vigo (Blatchley); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Cunningham); Steuben (Bradner).

G. TINCTORIUM L. Marsh Bedstraw.

(*G. trifidum latifolium* Torr.)

In damp places, such as marshes, dense woods or low grounds in rich soil. Quite common in all parts of the State, often being thrown with *trifidum* in collections.

Flowers from May until August.

Jefferson (Barnes); Noble (Van Gorder); Gibson and Posey (Schneck); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyneke); Putnam (MacDougal); Vermillion (Wright); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley).

G. TRIFIDUM L. Small Bedstraw. Small Cleavers.

The most widely distributed species of the genus, with perhaps the exception of *G. Aparine*. In bogs, low grounds and dense woods throughout the State.

Flowers from May until late in July.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyneke); Gibson and Posey (Schneck); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Cunningham); Vermillion (Wright); Kosciusko (Coulter); Daviess (Clements); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

G. CONCINNUM Torr. and Gray. Shining Bedstraw.

Frequent in dry, rocky or open woods in many parts of the State. Abundant wherever found.

Flowering in June and July.

Tipppecanoe (Hussey); Fayette (Hessler); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Daviess (Clements); Jay, Delaware, Randolph, and Wayne (Phinney); Putnam (MacDougal); Vermillion (Wright); Decatur (Ballard); Jefferson (Barnes).

G. ASPRELLUM Michx.

Confined to northern counties, where it is found in moist, sand soils.

Flowers in July and August.

Kosciusko (Coulter); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler); Marion; Hamilton (Wilson); Steuben (Bradner).

CAPRIFOLIACEÆ. Honeysuckle Family.**SAMBUCUS L.****S. CANADENSIS L.**

Abundant throughout the State in various situations. While common along roadsides and in open, waste places, it reaches its best development in moist, rich, alluvial soils. Flowers very fragrant and berries much used in wine making.

Flowers from May through August, often flowering twice in a season.

Tipppecanoe (Cunningham); Kosciusko (Coulter); Jefferson (J. M. Coulter); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Vermillion (Wright); Monroe and Vigo (Blatchley); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner); Fayette (Hessler).

S. PUBENS Michx. Red-berried Elder.

(*S. racemosa* Hook.)

Chiefly northern in its range in our boundaries. It is found associated with *S. Canadensis* and also in coarse, rocky soils. The pith forms a satisfactory means of recognition, being brown in this species and white in the preceding.

Flowers in May and June.

Putnam (MacDougal); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Noble (Van Gorder); Laporte and Porter (Hill); Kosciusko (Coulter); Steuben (Bradner).

VIBURNUM L.

V. OPULUS L. Cranberry-tree. High Bush-cranberry.

Sparingly found in a few widely separated counties, in low grounds, usually in rather sandy loam soils.

Flowering season, June and July.

Noble (Van Gorder); Jefferson and Tippecanoe (Hussey); Kosciusko (Chipman); Steuben (Bradner).

V. ACERIFOLIUM L. Maple-leaved Viburnum.

Found in all parts of the State in rather dry soil in clearings and rich woods. A rather handsome, branching shrub.

Flowering season, May and June.

Bartholomew and Jennings (Barnes); Tippecanoe (Hussey); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Jefferson (J. M. Coulter); Noble (Van Gorder); Putnam (MacDougal); Cass (Hessler); St. Joseph (Rothert); Hamilton (Wilson); Steuben (Bradner); Lake (Hill).

V. PUBESCENS (Ait.) Pursh. Downy-leaved Arrow-wood.

In central and eastern counties of the State, in rough, rocky woods and hillsides. Not at all abundant.

Collected in flower July 7.

Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Steuben (Bradner); Lake and Jefferson.

V. DENTATUM L. Arrow-wood.

In marshy thickets and damp, dense woods, chiefly in central and southern counties. Not reported from north of Tippecanoe County. Usually plentiful in the stations in which it occurs.

Flowers late in May and in June.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Tippecanoe.

V. MOLLE Michx. Soft-leaved Arrow-wood.

This species, although assigned a range far to the east of Indiana, undoubtedly belongs to our flora. It is confined to the southern counties, growing at the margins of dry, upland prairies.

Collected in flower in June.

Vigo (Blatchley); Jefferson (J. M. Coulter).

V. LENTAGO L. Nanny-berry. Sheep-berry.

In rich soil in open woods and by the borders of streams in the central and southern counties. A large shrub, often becoming tree-like in habit. The fruit, which ripens in October, is edible.

Flowering season, May and early June.

Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Putnam (MacDougal); Kosciusko (Coulter); Marion; Steuben (Bradner).

V. PRUNIFOLIUM L. Black Haw. Sloe. Stag-bush.

Throughout the State in fair abundance, growing in dry fields and on wooded slopes. In some localities it occurs as a small tree. The wood is hard, reddish-brown in color and occasionally used in making the handles of small tools. The fruit, which ripens in September, is sweet and edible.

Flowers in May and June.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Cunningham); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner); Fayette (Hessler).

TRIOSTEUM L.**T. PERFOLIATUM L. Fever-wort. Horse Gentian.**

Abundant throughout the State in rich soils, growing profusely in clearings and open woods. Intergrades with the next species, the two being very difficult to disentangle.

Flowers from April through June.

Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Jefferson (J. M. Coulter); Noble (Van Gorder); Putnam (MacDougal); Kosciusko (Coulter); Cass and Fayette (Hessler); Hamilton (Wilson); Steuben (Bradner); Marion.

T. ANGUSTIFOLIUM L. Narrow-leaved Horse Gentian.

In similar soils and of similar distribution as the preceding. Much less common.

Flowers in May and June.

Cass (Hessler); Daviess (Clements); Franklin (Meyncke); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

LINNÆA L.

L. BOREALIS L. Twin-flower. Ground Vine.

Growing in moist, pine woods, Pine Station. Collected June 7, 1884. This is the most southern station recorded for this definitely northern form. Detected as a member of the State flora by Rev. E. J. Hill.

Lake (Hill).

SYMPHORICARPOS Juss.

S. RACEMOSUS Michx. Snowberry.

In a few southern counties in rocky places, occasionally along the banks of streams. The species does not seem to be an "escape" in the localities in which it is found, but is evidently a member of the native flora.

Flowers in June and July.

Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Franklin (Meyncke); Steuben (Bradner).

S. OCCIDENTALIS Hook. Wolfberry.

I have seen a herbarium specimen of this species labelled Indiana, but without collector's name or data of any sort. Admitted upon the specimen.

Marion.

S. SYMPHORICARPOS (L.) MacM. Coral-berry. Indian Currant.

(*S. vulgaris* Michx.)

Not uncommon in various parts of the State. It is usually found in coarse, rocky or gravelly soils in either wet or dry situations.

Flowers in July.

Jefferson (J. M. Coulter); Putnam (MacDougal); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Marion, Monroe and Vigo (Blatchley).

LONICERA L.

L. HIRSUTA Eaton. Hairy Honeysuckle.

In damp copses and on rocks.

Flowers from June until July.

Steuben (Bradner).

L. DIOICA L. Smooth or Glaucous Honeysuckle.*(L. glauca Hill.)*

Not abundant in any part of the State, but found in several counties. Its greatest abundance is in the southern counties in rocky, hill regions. It is more sparingly found in the extreme northern counties in dry, sandy soil.

Flowering season, May and June.

Clark (Barnes); Noble (Van Gorder); Monroe (Blatchley); Lake and Tippecanoe.

L. SULLIVANTII Gray.

Reported from a single county in the State as growing in dry woodlands. I have seen no specimen, but the reference seems sufficiently definite to admit the form to the flora.

Randolph (Phinney).

L. SEMPERVIRENS L. Trumpet or Coral Honeysuckle.

On hillsides and in rather damp ground in several southern counties in considerable abundance. Not reported as occurring north of Wayne County. The species is largely cultivated and is one of our most ornamental climbing plants.

Flowers from April through the summer.

Jefferson (J. M. Coulter); Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke).

DIERVILLA Moench.**D. DIERVILLA (L.) MacM. Bush Honeysuckle.***(D. trifida Moench.)*

In the northern counties in dry, rocky woodlands.

Flowers from June until July.

Steuben (Bradner); Lake.

VALERIANACEÆ. Valerian Family.**VALERIANA L. Valerian.****V. PAUCIFLORA Michx.**

Apparently confined to the southern half of the State, becoming rarer as it reaches its northern limit. Its favorite home is in rich ravines or upon steep hillsides.

Flowers in May and June.

Reported from Jefferson, Clark, Gibson, Posey, Monroe, Franklin, Fayette, and Putnam counties; Hamilton and Marion (Wilson).

V. EDULIS Nutt.

Reported only from Cass County by Dr. Hessler. An examination of the specimens leaves no doubt of the accuracy of the reference.

V. SYLVATICA Banks.

Not of general distribution.

Reported from Jefferson County (Coulter); Putnam County (Underwood).

VALERIANELLA Tourn. Corn Salad. Lamb Lettuce.

V. LOCUSTA (L.) Bettke.

(*V. oltoria* Poll.)

Waste grounds in Jefferson County (Barnes).

V. CHENOPODIFOLIA (Pursh) DC. Goosefoot Corn Salad.

In moist, rather rich soils in the central and southern part of the State.

Flowers in May and June.

Hamilton and Marion (Wilson).

V. RADIATA (L.) DuRoi.

Of more general distribution, but confined in mass distribution to northern and eastern counties.

Reported from Cass (Hessler); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Fayette (Hessler); Putnam (MacDougal); Decatur (Ballard); Marion.

DIPSACACEÆ. Teasel Family.

DIPSACUS L. Teasel.

D. SYLVESTRIS Huds. Wild Teasel.

The mass distribution is found in the southern counties of the State, where its favorite station is upon barren slopes or along roadsides.

Its flowering period is from July to September.

Reported as follows: Monroe (Blatchley); Fayette (Hessler); Tippecanoe (Cunningham); Jefferson (Coulter); Putnam (MacDougal); Hamilton and Marion (Wilson); Steuben (Bradner).

CUCURBITACEÆ. Gourd Family.

MELOTHRIA L.

M. PENDULA L.

A local form confined so far as reports go to two counties bordering the Ohio River, viz., Clark (Baird and Taylor) and Jefferson (Coulter).

MICRAMPELIS Raf. Wild Balsam Apple.

M. LOBATA (Michx.) Greene.

(*Echinocystia lobata* Torr. and Gray.)

A form of general distribution reported definitely from 17 counties. It is more frequent in the northern counties, as its general range would indicate.

Its flowering season is from July to September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jay, Delaware, Wayne, and Randolph (Phinney); Gibson and Posey (Schneck); Noble (Van Gorder); Franklin (Meyncke); Putnam (MacDougal); Vigo and Monroe (Blatchley); Carroll, Marion, Hamilton (Wilson).

SICYOS L. One-seeded Bur-cucumber.

S. ANGULATUS L.

More abundant in the northern and eastern portions of its area in the State.

It flowers from July to September, and finds its best conditions along the banks of streams.

This species, as well as the one preceding, are coming into general cultivation as ornamental climbers.

Reported stations: Kosciusko (Coulter); Jay, Delaware, Wayne, and Randolph (Phinney); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Noble (Van Gorder); Franklin (Meyncke); Putnam (Underwood); Tippecanoe (Golden); Monroe and Vigo (Blatchley); Fayette (Hessler); Hamilton and Marion (Wilson).

CAMPANULACEÆ.

CAMPANULA L. Bellflower.

C. ROTUNDIFOLIA L. Harebell.

Found only in the northern part of the State. The stations reported are Laporte (Barnes); Lake (E. J. Hill); Kosciusko (Chipman); Steuben (Bradner); Cass and Marshall (Hessler).

C. ROTUNDIFOLIA LANGSDORFIANA (A. DC.) Britton.*(C. rotundifolia arctica Lange.)*

This form is also confined to the region about Lake Michigan, with the exception of a station in Cass County.

Reported from Laporte (Barnes); Lake (Hill); Cass (Hessler).

C. APARINOIDES Pursh. Marsh Bellflower.

A somewhat common form in the marsh lands of the northern counties. Its habit of growing in grassy grounds perhaps accounts for the few stations definitely reported.

Tippecanoe (Cunningham); Kosciusko (Coulter); Laporte (Barnes); Lake (Barnes); Marshall (Coulter); Steuben (Bradner).

C. DIVARICATA Michx. Panicled Bellflower.

On rocky banks and hillsides.

Flowers from June until September.

Monroe (Dudley).

C. AMERICANA L. Tall Bellflower.

Generally distributed throughout the State, but reaching its highest development in rich, wet soil. In such regions it frequently reaches a height of 10 feet, with the spicate inflorescence covering from two and one-half to three feet. In dry localities the size is much reduced, the petioles as a rule are without margins and the epidermis is very manifestly thickened.

The flowering season opens in June and continues until in September.

Specimens examined from Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (Barnes); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

LEGOUZIA Durand.**L. PERFOLIATA (L.) Britton. Venus's Looking-glass.***(Specularia perfoliata A. DC.)*

In exposed situations in rather poor soil.

The flowering season extends from May through August. The flowers are open in the earlier hours of the day, usually closing between two and three o'clock or on bright, sunny days as early as noon.

Tippecanoe (Cunningham); Jefferson and Kosciusko (Coulter); Daviess (Clements); Knox (Spillman); Hamilton and Marion (Wilson); Cass (Hessler); Vigo and Monroe (Blatchley).

LOBELIA L.

L. CARDINALIS L. Cardinal Flower.

Occasional throughout the State, very common in low grounds in the more northern counties. In the height of its flowering season in August it frequently gives its deep red color to acres of lowlands adjoining the smaller inland lakes. In the deeper shade the flowering extends into September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (Barnes); Round Lake (Deam); Fayette (Hessler); Knox (Spillman); Hamilton and Marion (Wilson); (Steuben (Bradner); Vigo and Monroe (Blatchley).

L. SYPHILITICA L. Great Lobelia.

The most abundant form in the State. While it reaches its maximum development in low, rich soils, it maintains itself well in dry regions, the adaptations apparently being chiefly a reduction in leaf surface. No especial thickening of the epidermis was observed in sections from a large number of specimens.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (Barnes); Vermillion (Wright); Knox (Spillman); Decatur (Ballard); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner); Vigo and Monroe (Blatchley).

Flowering season, August and September.

L. PUBERULA Michx.

Usually found in moist, light soil, flowering in July and August. It is fairly distributed throughout the State in all probability, but definite reports have been received from but few counties.

Kosciusko (Coulter); Daviess (Clements); Tippecanoe (Hussey); Jefferson (Barnes); Hamilton and Marion (Wilson); Monroe and Carroll.

L. SPICATA Lam.

Confined to the northern counties, where it usually occurs in gravelly soil.

Flowers late in July and August. Forms in dry soil flower from one to two weeks earlier than those in low, wet grounds.

Reported from Tippecanoe (Cunningham); Cass (Hessler); St. Joseph (Barnes); Lake (Hill); Kosciusko (Coulter); Laporte (Coulter); Jefferson and Monroe.

L. LEPTOSTACHYS A. DC.

Of practically the same range as the last. It is perhaps more limited in its soil range, being confined so far as my observations go to sandy soils, while *L. spicata* grows vigorously in a clayey loam.

L. INFLATA L. Indian Tobacco.

Found throughout the State in dry, sunny regions. The plant is used somewhat largely in quack remedies, but the plant is poisonous and such decoctions should be rigidly avoided.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner); Vigo and Monroe (Blatchley).

It flowers from July to September, its more apparent mass distribution being in the southeastern counties.

L. KALMII L.

A form confined to wet soils in the northern counties of the State. It is distinguished from *L. Nuttallii* by having the bracts above the middle of the pedicel, while in the latter form they are at the base. In the early flowering season the pedicels are quite short, and bracted near the base; later in the season the pedicels are much longer and the bracts above the middle. *L. Nuttallii* is probably not a member of the State flora, and several references to that form are included under this citation.

Tippecanoe (Cunningham); Kosciusko (Coulter); Cass (Hessler); Noble (Van Gorder); Lagrange (Barnes); Steuben (Bradner).

CICHORIACEÆ. Chicory Family.**CICHORIUM L.****C. INTYBUS L. Chicory.**

Found in waste places and by roadsides throughout the State. The plant was largely cultivated during the Civil War, its root being used as a substitute for coffee. Whether its distribution, which is becoming more general, represents escaped forms can not now be determined. It collects in patches and is very persistent.

Flowers in July and August.

Noble (Van Gorder); Jefferson (Coulter); Wabash (Jenkins); Kosciusko (Coulter); Steuben (Bradner); Marion.

ADOPOGON Neck.

A. VIRGINICUM (L.) Kuntze. Virginia Goatsbeard.

(Krigia amplexicaulis Nutt.)

Common throughout the State in moist woods and opens, thriving best in fairly rich, loam soil.

Flowers from May through July.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Knox (Spillman); St. Joseph (Rothert); Fayette (Hessler); Steuben (Bradner).

A. DANDELION (L.) Kuntze. Dwarf Dandelion.

(Krigia Dandelion Nutt.)

Confined to the southern counties of the State, growing in moist, rather thin soils.

Flowering season, from April until late in June.

Jefferson and Floyd (Barnes); Clark (Baird and Taylor); Gibson and Posey (Schneck); Hamilton (Wilson).

A. CAROLINIANUM (Walt.) Britton.

(Krigia Virginica Willd.)

In dry, sandy soil, confined to the extreme northern counties of the State. An abundant beach plant near Michigan City.

Flowers from late in April through August.

Laporte (Barnes); Lake.

TRAGOPOGON L.

T. PRATENSIS L. Yellow Goatsbeard.

Reported from a single county as occurring along railroads. Evidently a migrant from the east. Detected by Dr. Robert Hessler and verified by herbarium specimens.

Marion (Hessler).

TARAXACUM Hall.

T. TARAXACUM (L.) Karst. Dandelion.

(T. officinale Weber.)

Well known throughout the State, though only becoming annoying when it invades lawns. Its roots are still somewhat used as an adulterant of coffee, and its young leaves as greens.

It blooms practically throughout the entire year in favorable situations. Mr. E. A. Schultze reported specimens in flower and

fruit January 1, 1899, at Fort Wayne. The plants had apparently blossomed under the snow and had fruited so abundantly that the surrounding grass was whitened with the pappus. An examination of specimens showed the achenes to be fully viable.

Tippecanoe (Cunningham); Kosciusko (Coulter); Jefferson (Barnes); Putnam (MacDougal); Dearborn (Collins); Clark (Baird and Taylor); Franklin (Meyncke); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); St. Joseph (Rothert); Decatur and Shelby (Ballard); Wabash (Jenkins); Allen (Schultze); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

SONCHUS L.

S. OLERACEUS L. Sow-thistle.

Abundant in fields and waste places except in the extreme northern part of the State. The very early leaves are somewhat used for greens.

Flowers from May until the heavy frosts.

Tippecanoe (Cunningham; Vigo (Blatchley); Franklin (Meyncke); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Putnam (MacDougal); Fayette (Hessler); Marion; Steuben (Bradner); Gibson.

S. ASPER (L.) All. Spiny Sow-thistle.

In similar localities as the preceding and of much the same distribution. Both species are common but not troublesome weeds.

Jefferson (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Clark (Baird and Taylor); Fayette (Hessler); Marion; Monroe; Hamilton (Wilson); Steuben (Bradner)

LACTUCA L.

L. SCARIOLA L. Prickly Lettuce.

This species attracted attention a few years ago because of its very rapid spread in waste places and its consequent invasion of cultivated areas. The careful study of the plant published by Dr. Arthur, of the Purdue Experiment Station, precludes the necessity of any fuller discussion of the plant in this place. In many districts, especially where sheep are kept, it is not considered a very troublesome weed, the sheep and other stock readily eating the young leaves. It is now of wide distribution, and

vigorous measures should be taken to prevent its further spread.

It flowers usually in August and September, occasionally continuing to flower until late in October.

Tippecanoe (Cunningham); Kosciusko (Coulter); Cass and Fayette (Hessler); Noble (Van Gorder); Putnam (Underwood); Wabash (Jenkins); Hamilton and Marion (Wilson).

L. CANADENSIS L. Wild Lettuce.

Very abundant in almost every part of the State, ordinarily in moist soil. Found in the edges of cultivated fields, by roadsides and in almost any situation where the soil has been recently broken. An annoying weed in many counties.

Flowers from July until October.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Jefferson (Barnes); Putnam (MacDougal); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyneke); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Decatur and Shelby (Ballard); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

L. HIRSUTA Muhl. Hairy Wood Lettuce.

Found only in the southern counties of the State in dry soil. Not abundant. Stem and peduncles very often red or purple.

Flowers in July and August.

Vigo (Blatchley); Gibson and Posey (Schneck); Clark (Baird and Taylor).

L. SAGITTIFOLIA Ell. Arrow-leaved Lettuce.

(*L. integrifolia* Bigel.)

In many counties in dry, open rather sandy soil in fair abundance. More abundant in the southern than in the northern counties.

Flowers from July until September.

Noble (Van Gorder); Franklin (Meyneke); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Daviess (Clements); Putnam (MacDougal); Fayette (Hessler).

L. PULCHELLA (Pursh) DC. Large Blue-flowered Lettuce.

Evidently a migrant. Reported from a single station in the State by Dr. MacDougal. Found in moist soil along the right of way of a railroad.

Collected in flower in August.

Putnam (MacDougal).

L. VILLOSA Jacq. Hairy-veined Blue Lettuce.*(L. acuminata Gray.)*

In several counties of the State in moist thickets and along streams. Nowhere abundant.

Flowers from July through September.

Tippecanoe (Cunningham); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Putnam (MacDougal); Cedar Lake (Deam).

L. FLORIDANA (L.) Gaertn. False Lettuce.

Reported only from the southern counties of the State in moist, open places. Not abundant in any of its stations.

Flowering season, July to September.

Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Franklin (Meyncke).

L. SPICATA (Lam.) Hitchk. Fall Blue Lettuce.*(L. leucophæa Gray.)*

Not abundant but found in several counties, chiefly southern, in damp, rather rich soils. Not reported as occurring north of Kosciusko County.

Flowers from July through September.

Kosciusko (Coulter); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Fayette (Hessler); Monroe and Vigo (Blatchley); Steuben (Bradner).

HIERACIUM L.**H. VENOSUM L. Rattlesnake-weed. Poor Robin's Plantain.**

In the southern counties of the State in dry, shaded places. Not reported as occurring north of Monroe County.

Flowers from late in June through September.

Jefferson and Clark (Barnes); Monroe (Blatchley).

H. CANADENSE Michx. Canadian Hawkweed.

This form of northern mass distribution is found only in the extreme northern counties of the State. First collected by Rev. E. J. Hill.

Flowering season, August and September.

Lake (Hill); Steuben (Bradner).

H. PANICULATUM L. Panicked Hawkweed.

In central and southern counties in dry woods or thickets in relative abundance.

Flowers from July until in September.

Johnson and Floyd (Barnes); Monroe (Blatchley); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Putnam (MacDougal).

H. SCABRUM Michx. Rough Hawkweed.

Abundant in many parts of the State. Indicative of dry soil, usually occurring in thickets or recent clearings.

Flowers from July through September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Harrison (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Noble (Van Gorder); Jefferson (J. M. Coulter); Franklin (Meyncke); Clark (Baird and Taylor); Gibson and Posey (Schneck); Round Lake (Deam); Fayette (Hessler); Steuben (Bradner).

H. GRONOVII L. Hairy Hawkweed.

Not uncommon in several counties, and probably of general occurrence. Found in dry soil in open woods or thickets.

Flowers from July through September.

Kosciusko (Coulter); Harrison and Floyd (Barnes); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Carroll; Steuben (Bradner); Lake (Hill); Tippecanoe; Vigo (Blatchley).

H. LONGIPILIUM Torr. Long-bearded Hawkweed.

Reported only from the southwestern counties of the State, occurring in open places and dry woods.

Collected in flower in August.

Gibson and Posey (Schneck); Steuben (Bradner); Vigo (Blatchley).

NABALUS Cass.**N. ALTISSIMUS (L.) Hook. Tall White Lettuce.**

(*Prenanthes altissima* L.)

Common in many parts of the State in relatively shaded places. Most abundant in damp, rich soils. In greatest abundance in southern counties of the State.

Flowers from late in July until October.

Tippecanoe (Cunningham); Kosciusko (Coulter); Jefferson (Barnes); Monroe and Vigo (Blatchley); Noble (Van Gorder); Clark (Baird and Taylor); Gibson and Posey (Schneck); Wabash (Jenkins); Putnam (MacDougal); Fayette (Hessler); Steuben (Bradner).

N. ALBUS (L.) Hook. Rattlesnake Root. White Lettuce.*(Prenanthes alba L.)*

Difficult to separate from the preceding, both species being very variable and intergrading. In woods and thickets in many parts of the State.

Flowers from August through September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Jefferson (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Marion; Monroe; Steuben (Bradner).

N. ASPER (Michx.) T. and G. Rough White Lettuce.*(Prenanthes aspera Michx.)*

Reported chiefly from the southern counties, where it occurs in dry, open places. Not abundant in any station.

Flowers from August through September.

Clark (Baird and Taylor); Jefferson (J. M. Coulter); Steuben (Bradner).

N. RACEMOSUS (Michx.) DC. Glaucous White Lettuce.*(Prenanthes racemosa Michx.)*

Reported only from the northern part of the State, not being reported as occurring south of Cass County. Rather abundant in stations in which it occurs, which are usually moist, open places.

Flowering in August and September.

Cass (Hessler); Noble (Van Gorder); Lake (Hill); Wabash (Jenkins); Steuben (Bradner).

N. CREPIDINEUS (Michx.) DC. Corymbed Rattlesnake Root.*(Prenanthes crepidinea Michx.)*

Not uncommon in widely separated counties, usually growing in fields and thickets in rather dry localities. It is absent from the extreme northern counties, and is found most plentifully in its southern stations.

Flowers later than the other members of the genus, rarely before September, and continuing through October.

Clark (Baird and Taylor); Franklin (Meyneke); Jefferson (J. M. Coulter); Tippecanoe (Conner and Laben); Fayette (Hessler); Wabash (Jenkins).

AMBROSIACEÆ. Ragweed Family.**AMBROSIA L.****A. BIDENTATA Michx. Lance-leaved Ragweed.**

Found only in the central and southern counties of the State. Found in open places, either prairies or clearings. Prefers a rich, loose soil.

Flowers in August and September.

Vigo and Clay (Blatchley); Gibson and Posey (Schneck); Putnam (MacDougal).

A. TRIFIDA L. Great Ragweed Horse-weed.

Abundant and widely distributed in all parts of the State. The species reaches its highest development both as to numbers and size in rich, alluvial soils subject to overflow. It also invades cultivated fields and along their borders often forms a dense thicket.

Flowers from July until the frosts.

Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Cunningham); Kosciusko; Hamilton and Marion (Wilson); Steuben (Bradner).

A. TRIFIDA INTEGRIFOLIA (Muhl.) T. and G.

Associated with the former in certain parts of its range, but much less abundant and less widely distributed. As the preceding, it has a strong vitality, growing up time and again from the stumps left from cutting.

Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Franklin (Meyncke); Vigo (Blatchley); Fayette (Hessler); Hamilton (Wilson).

A. ARTEMISIAEFOLIA L. Ragweed. Wild Tansy.

The most abundant species of the genus in our bounds. It is found in all parts of the State in waste places and cultivated fields. While it frequently takes complete possession of fallow ground and encroaches heavily upon cultivated areas, it is regarded by many farmers as beneficial to the land. I have been unable to get any clear reason for this belief. It is certainly with

us a prevalent if not a pernicious weed. The pollen of the plant is popularly supposed to cause hay fever.

Flowering season, from July through October.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Daviess (Clements); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Cunningham); Kosciusko (Coulter); Wabash (Jenkins); Hamilton and Marion (Wilson); Steuben (Bradner).

A. PSILOSTACHYA DC. Western Ragweed.

Reported as a member of the State flora by Dr. Robert Hessler. Abundant herbarium specimens verify the reference. The general distribution of the plant is to the west of our range. It probably entered the State along the line of east and west railroads. It is as yet a local form of no general distribution. Usually in moist soils.

Flowers from July through September.

Marshall and Marion (Hessler).

XANTHIUM L.

X. SPINOSUM L. Spiny Cocklebur. Burweed.

In the southern and central counties of the State, not extending north of Putnam County. Quite abundant in the extreme southern part of the State in waste places and along roadsides.

Flowers from August until November.

Jefferson (Barnes); Putnam (MacDougal); Clark (Baird and Taylor); Franklin (Meyncke).

X. STRUMARIUM L. Cocklebur. Bur-thistle.

In all parts of the State, abundant in alluvial soils and cultivated fields. A very persistent and annoying weed, which seems to increase in numbers with the increase in the tilled area.

Flowers in August and September.

Vigo and Monroe (Blatchley); Fayette (Hessler); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Putnam (MacDougal); Hamilton and Marion (Wilson); Steuben (Bradner).

X. CANADENSE Mill. Hedgehog Burweed.

Sparingly found in the central counties of the State. First collected by Dr. L. M. Underwood near Greencastle. Along the banks of streams or in high, sandy soils.

Collected in flower in September, but probably commencing to bloom in August.

Tippecanoe (Cunningham); Putnam (Underwood); Hamilton and Marion (Wilson); Vigo (Blatchley).

COMPOSITÆ. Thistle Family.**VERNONIA Schreb.****V. NOVEBORACENSIS (L.) Willd. Ironweed.**

Found throughout the State, but especially abundant in the southern counties. It grows in moist bottom lands in great luxuriance, at times reaching a height of 12 feet. It is also found in moderately dry opens and prairies.

Flowers July to September.

Franklin (Meyneke); Gibson and Posey (Schneck); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Jefferson (J. M. Coulter); Vigo (Blatchley); Decatur (Ballard); Monroe; Lake (Hill).

V. GIGANTEA (Walt.) Britton. Tall Ironweed.

(*V. altissima* Nutt.)

This form was first detected in Tippecanoe County by Messrs. Conner and Laben in 1896. Since that time I have found the species in many collections labelled *V. fasciculata*. I believe it to be of general distribution in the northern part of the State. In a general way the plant has the inflorescence and achene of *Noveboracensis*, the involucreal scales of *fasciculata* and leaves intermediate between the two. It is found most abundantly in moist soils, along streams.

The flowering season begins late in July and continues until late in September. The station in Tippecanoe County cited above is the only one definitely reported. It occurs, however, in collections from White, Wabash, Marshall and Kosciusko.

V. FASCICULATA Michx. Western Ironweed.

This form is of very general distribution throughout the State, in some cases becoming so abundant as to prove very troublesome. It is found especially abundant in upland soils, and often invades pastures and woodlands.

Its flowering season is from July through September.

Jefferson (Barnes); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Fayette (Hessler); Daviess (Clements); Franklin (Meyneke); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Kosciusko (Coulter); Hamilton and Marion (Wilson); Steuben (Bradner).

ELEPHANTOPUS L.

E. CAROLINIANUS Willd. Elephant's-foot.

Confined to the southern counties of the State. It occurs in dry, rich soil and is nowhere abundant except in Gibson, Crawford and Posey counties.

It flowers in our range in July and August.

Vigo and Crawford (Blatchley); Daviess (Clements); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Clark (Baird and Taylor).

EUPATORIUM L.

E. MACULATUM L. Spotted Joe-Pyeweed.

This species is, as a rule, not distinguished in local collections from *E. purpureum*, with which it is generally associated, and with which it intergrades. It is much less common and of smaller size. Grows in moist soils.

Flowers in August and September.

Hamilton and Marion (Wilson).

E. PURPUREUM L. Joe-Pye or Trumpetweed. Purple Boneset.

Very abundantly distributed, being most abundant in low, wet grounds. In favorable localities, along streams or low lake margins, it reaches a height of from 10 to 15 feet and is the most conspicuous plant feature.

Flowering season, from late in July until the frosts.

Carroll (J. M. Coulter); Monroe and Vigo (Blatchley); Fayette (Hessler); Daviess (Clements); Franklin (Meyneke); Gibson and Posey (Schneck); Putnam (MacDougal); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Tippecanoe (Cunningham); Kosciusko (Coulter); Knox (Spillman); Round Lake (Deam); Hamilton and Marion (Wilson); Steuben (Bradner).

E. PURPUREUM FALCATUM (Michx) Britton.

Probably found associated with the species throughout its range in the State. Definitely reported from Hamilton and Marion counties by Mr. G. W. Wilson. Many varietal forms of equal distinctness might be established, as is this, upon leaf characters, since *purpureum* is one of our most variable species.

E. SEROTINUM Michx. Late-flowering Thoroughwort.

Found chiefly in the southern part of the State, having no reported locality north of Tippecanoe County. Found in various localities, but most abundant in gravelly banks; it is also found in moist woodlands, though not in as great abundance.

Flowers in August and September.

Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Clark (Baird and Taylor); Tippecanoe (Coulter); Daviess (Clements); Steuben (Bradner).

E. HYSSOPIFOLIUM L. Hyssop leaved Thoroughwort.

In dry fields and fence rows. Reported from but one county. Flowers from August until September.

Tippecanoe.

E. ALTISSIMUM L. Tall Thoroughwort.

Occasional in a few counties of the State, growing in dry, rather coarse soils.

Flowers late in July.

Tippecanoe (Conner and Laben); Dearborn (Collins); Clark (Baird and Taylor); Franklin (Meyneke); Marion (Wilson); Gibson.

E. SESSILIFOLIUM L. Upland or Bastard Boneset.

Usually growing in dry woods, sometimes extending into the opens. In Gibson and Posey it is found growing abundantly in moist soils. Its range is such as to lead to the belief that it is to be found in all parts of the State.

Flowers July to September.

Floyd (Barnes); Tippecanoe (Wright); Putnam (MacDougal); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyneke); Gibson and Posey (Schneck); Cass (Hessler); Johnson (Barnes).

E. PERFOLIATUM L. Common Thoroughwort. Boneset.

Abundant in low, wet grounds throughout the State. It apparently reaches its best development in rich soils. No plant is more generally known and its use as a household remedy is, or has been, so universal as to give it the popular name of "Ague Weed" in many parts of the State.

Flowers from July until the heavier frosts.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Fayette (Hessler); Daviess (Clements); Putnam (MacDougal); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Dearborn (Collins); Franklin (Meyneke); Gibson and Posey (Schneck); Kosciusko (Coulter); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

E. AGERATOIDES L. f. White Snake-root. Milk-sick Weed.

Usually found in rich soil in woods, extending also into the open. Its best development is found, however, in shaded places. In the southwestern counties of the State the specimens are almost without exception pubescent instead of smooth.

Flowers from July until October.

This species is very commonly associated in the popular mind with the occurrence of milk sickness in cattle. There seems no justification for the belief, and the Department of Agriculture does not include it in the list of plants "known or suspected to be" injurious to stock.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette and Cass (Hessler); Daviess (Clements); Noble (Van Gorder); Tippecanoe (Cunningham); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Dearborn (Collins); Franklin (Meyneke); Gibson and Posey (Schneck); Kosciusko (Coulter); Hamilton and Marion (Wilson).

E. COELESTINUM L. Mist-flower.

Rather abundant in the southern counties of the State, where it is found in rich, open woods. It is the most delicate species of the genus and is coming into somewhat extended use as an ornamental plant.

Flowers from July until in October.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Franklin (Meyneke); Gibson and Posey (Schneck); Marion and Hamilton (Wilson).

WILLUGHBEA Neck.

W. SCANDENS (L.) Kuntze. Climbing Hemp-weed or Boneset.
(*Mikania scandens* Willd.)

Abundant in favorable localities throughout the State. It is always found in moist places, making an equally abundant growth either in sandy soil or in the mucky soils bordering lakes. It frequently covers bushes along streams over a very considerable area, in some cases actually smothering the supporting shrubs.

Flowers July to September.

Gibson and Posey (Schneck); Porter (Blatchley).

KUHNTIA L.

K. EUPATORIODES L. False Boneset.

Found in dry, usually sandy soil in several counties of the State. The species prefers the open and is rarely found in shaded places. More abundant in southern portion of State.

Flowers in August and September.

Vigo (Blatchley); Putnam (MacDougal); Tippecanoe (Wright); Franklin (Meyncke); Marion and Hamilton (Wilson); Gibson.

LACINARIA Hill.

L. SQUARROSA (L.) Hill. Scaly Blazing Star. Colic-root.
(*Liatris squarrosa* Willd.)

Reported definitely only from Gibson and Posey counties by Dr. J. Schneck, who reports it as rare. Probably of much wider distribution. It is found with us in dry soil, flowering in July.

L. CYLINDRACEA (Michx.) Kuntze. Cylindric Blazing Star.
(*Liatris cylindracea* Michx.)

In dry soil, chiefly in open prairies. Not especially abundant in any of its stations.

Flowering in August and September.

St. Joseph (Barnes); Lake (Hill); Gibson and Posey (Schneck).

L. PYCNOSTACHYA (Michx.) Kuntze. Prairie Snake-root.
(*Liatris pycnostachya* Michx.)

Found in prairies throughout northern part of State, usually growing in moist places. Found also, though less abundantly, in similar situations in southwestern counties.

Flowers from July to September.

St. Joseph and Jasper (Barnes); Gibson and Posey (Schneck); Vigo (Blatchley).

L. SCARIOSA (L.) Hill. Large Button Snake-root.*(Liatris scariosa Willd.)*

Not common in any region but occurring in many counties. It is more commonly found in open places in dry, rocky soil. Is more abundant in north-central and western part of State than elsewhere.

Flowers August to October.

Cass (Hessler); St. Joseph (Barnes); Noble (Van Gorder); Vigo (Blatchley); Gibson and Posey (Schneck); Harrison (Barnes); Steuben (Bradner); Lake (Hill).

L. SPICATA (L.) Kuntze.*(Liatris spicata Willd.)*

In moist prairies or open bottom lands in several counties. It is rarely found in great numbers in any of its stations.

Flowers from August to October.

Tippecanoe (Cunningham); Kosciusko (Coulter); Cass (Hessler); Vigo (Blatchley); St. Joseph (Barnes); Floyd (Clapp); Noble (Van Gorder); Lake; Steuben (Bradner).

GRINDELIA Willd.**G. SQUARROSA (Pursh) Dunal. Broad-leaved Gum-plant.**

Reported from Cass County by Dr. Robert Hessler and verified by herbarium specimens. It is a southern and western form and is probably a migrant in Indiana.

Flowering in July and perhaps August.

CHRYSOPSIS Nutt.**C. VILLOSA (Pursh) Nutt. Hairy Golden Aster.**

Banks of streams and rather moist prairies in southern counties. Quite abundant in stations in which it is found. The plant is really a dry soil form, but most of its Indiana stations are in moist soils.*

Vigo (Blatchley); Daviess (Clements).

SOLIDAGO L.**S. SQUARROSA Muhl. Ragged Golden Rod.**

In dry, rocky soil in the "barrens" of the Knob region near New Albany, Floyd County. Collected by Dr. A. Clapp in 1837 and not since reported from the State. Specimens of Clapp's collection are in the Purdue herbarium.

*The Vigo County plants grow on dry, sandy banks.—W. S. B.

S. PETIOLARIS Ait. Downy Ragged Golden Rod.

Specimens collected by Baird and Taylor in Clark County have been referred to this species. While the specimens are not entirely satisfactory, there seems no reason to doubt the accuracy of the reference. The plant came into the flora from the southwest.

S. CAESIA L. Blue stemmed Golden Rod. Wreath Golden Rod.

One of our most abundant and widely distributed forms. It is most abundant in rich, moist soils in shaded places, although it is not unusual in rocky banks.

Flowering season begins in August and continues until the heavy frosts.

All forms from Indiana labelled *S. Curtisii* T. and G. are referred to this species. The two are very similar, being, perhaps, mere geographical species, but *Curtisii* is a mountain form ranging well to the east.

Jefferson (Barnes); Tippecanoe (Cunningham); Vigo and Monroe (Blatchley); Fayette (Hessler); Daviess (Clements); Putnam (MacDougal); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Dearborn (Collins); Franklin (Meyneke); Gibson and Posey (Schneck); Kosciusko (Coulter); Hamilton and Marion (Wilson); Steuben (Bradner).

S. FLEXICAULIS L. Broad-leaved Golden Rod.

(*S. latifolia* L.)

A common form, widely distributed. It is usually found in rich soil in moist, shady localities. Very abundant on shaded banks of streams and lakes and in low thickets.

Flowers in September and October.

Tippecanoe (Cunningham); Cass (Hessler); Jefferson (Barnes); Putnam (MacDougal); Vigo (Blatchley); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyneke); Tippecanoe (Coulter); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner); Monroe.

S. BICOLOR L. White Golden Rod.

Apparently confined to the central and southern counties. Nowhere abundant.

Flowers September and October.

Jefferson (Barnes); Monroe (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Scott (Barnes); Tippecanoe (Cunningham); Putnam (MacDougal); Allen.

S. STRICTA Ait. Willow-leaf Golden Rod.

Confined to the northern parts of the State, growing in wet, sandy soil.

Flowering in September and October.

Tippecanoe (Hussey); St. Joseph (Barnes); Noble (Van Gorder); Steuben (Bradner); Lake (Hill).

S. ULIGINOSA Nutt. Bog Golden Rod.

Not reported except from the swamp regions of the northern counties. In some of its stations it is fairly abundant, but as a rule is not found in large numbers.

Flowers in September and October.

In Lake County it is found in peat bogs.

Lake (Hill); Noble (Van Gorder); Cass (Hessler); St. Joseph (Barnes); Wabash (Jenkins).

S. SPECIOSA Nutt. Showy Golden Rod.

A tall, showy form, not infrequent in rich soils near the border of prairies. It is probably to be found throughout the State, although definitely reported from but few counties.

Vigo (Blatchley); Dearborn (Collins); Cass (Hessler); Tippecanoe (Ives); Hamilton and Marion (Wilson); Steuben (Bradner).

S. RIGIDIUSCULA (T. and G.) Porter. Slender Showy Golden Rod.

(*S. speciosa angustata* T. and G.)

In dry soil on prairies or in open lands. Reported only from Vigo County by Mr. W. S. Blatchley. It is probably not generally separated from *S. speciosa*.

S. PURSHII Porter.

(*S. humilis* Pursh.)

In our region this is a sand soil plant. It is recorded from Lake County by Mr. Hill, and as a member of the sand-dune floras of Lake and Porter counties by Dr. Cowles. So far as reports indicate, it is not found other than in connection with the dune flora.

S. VIRGAUREA GILLMANI (Gray) Porter.

(*S. humilis Gillmani* Gray.)

Found in Lake and Porter counties as a member of the flora of the "naked" and "evergreen" dunes. In this region it is quite abundant. Not reported from any other locality.

S. ODORA Ait.

Occasionally found in the southwestern counties of the State. Dr. Schneck reports it as scarce in Gibson and Posey counties, where it grows in sandy soil. Mr. Blatchley reports it as rare on prairies in Vigo County.

Flowers in our area in July and August.

S. RUGOSA Mill. Wrinkle-leaved or Rough-leaved Golden Rod.

A common and variable species growing in dry, open fields or along roadsides. More abundant in the central and southern parts of the State.

Jefferson (Barnes); Monroe (Dudley); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Dearborn (Collins); Franklin (Meyncke); Tippecanoe (Cunningham); Gibson and Posey (Schneck); Cass (Hessler); Lake (Hill); Vigo (Blatchley); Steuben (Bradner).

S. PATULA Muhl. Spreading Golden Rod.

Found in swampy or marsh regions in several counties of the State. Usually abundant in its northern stations, much less so in the central and becoming rare in the southern.

Cass (Hessler); Noble (Van Gorder); Jay, Delaware, Wayne and Randolph (Phinney); Gibson and Posey (Schneck); Steuben (Bradner).

S. ULMIFOLIA Muhl. Elm-leaved Golden Rod.

An abundant form, widely distributed. Usually found in moist, shaded places, though not uncommon in moist fields and prairies. One of our most characteristic forms.

Flowers from July to September.

Jefferson (Barnes); Vigo and Monroe (Blatchley); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke); Tippecanoe (Cunningham); Gibson and Posey (Schneck); Cass (Hessler).

S. NEGLECTA T. and G. Swamp Golden Rod.

Probably of general distribution in swamps and marshes. Definite reports, however, have been received from but few counties.

Flowers in August and September.

Jefferson (J. M. Coulter); Clark (Baird and Taylor).

S. JUNCEA Ait. Sharp-toothed Golden Rod.

Found sparingly in dry, coarse, even rocky soil. Only a few stations have been reported.

The species flowers in June and continues blooming until in September.

Monroe (Blatchley); St. Joseph (Barnes); Jefferson (J. M. Coulter).

S. ARGUTA Ait. Cut-leaved Golden Rod.

Confined largely to the northern part of the State, where it is found in rich soils in shaded situations.

Flowers July to October.

Cass (Hessler); St. Joseph (Barnes); Tippecanoe (Wright); Jefferson, Gibson, and Monroe.

S. RUPESTRIS Raf. Rock Golden Rod.

Reported from Clark County by Baird and Taylor. Found growing on exposed limestone bluffs.

Collected in flower in August.

S. SEROTINA Ait. Late Golden Rod.

Found in moist, rich soil, chiefly in bottom lands. Of most frequent occurrence in the southern counties, not extending north of Jasper.

Flowers late in August and in September.

Jefferson (J. M. Coulter); Jasper (Barnes); Vigo (Blatchley); Noble (Van Gorder); Franklin (Meyncke); Hamilton (Wilson); Marion; Fayette (Hessler).

S. SEROTINA GIGANTEA (Ait.) Gray.

Associated with the former and growing in similar places. Not so widely distributed, according to reports that have come to my hands.

Jefferson (J. M. Coulter); Jasper (Barnes); Franklin (Meyncke); Steuben (Bradner).

S. MISSOURIENSIS Nutt.

Either in dry prairies or in dry and sandy shady places. Fairly abundant in its northern location, rare in its southern.

Flowers very late with us, usually in October, although in open places flowers occasionally open in September.

Jasper (Barnes); Gibson and Posey (Schneck).

S. SHORTII T. and G.

Confined to southern counties, where it grows on exposed cliffs or in rocky soils. Quite abundant at the Falls of the Ohio. Floyd (Dr. Clapp); Clark (Baird and Taylor).

S. CANADENSIS L. Canada Golden Rod.

A very abundant and variable form of wide distribution in the State. It usually indicates dry soil and is very abundant along roadways and in abandoned fields.

Flowers August to November.

Vigo and Monroe (Blatchley); Fayette (Hessler); Daviess (Clements); Jefferson (Barnes); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke); Tippecanoe (Cunningham); Gibson and Posey (Schneck); Kosciusko (Coulter); Putnam (MacDougal); Steuben (Bradner); Cass (Hessler).

S. CANADENSIS SCABRIUSCULA Porter.

Found with the preceding in Vigo County, but not frequent. The station as reported by Mr. W. S. Blatchley is along the Vandalia railroad at Heckland.

S. NEMORALIS Ait. Field Golden Rod.

Well distributed throughout the State in dry soil, usually in the open. In Gibson and Posey counties it is found in moist localities associated with *S. rigida*.

Flowers in August and September.

Vigo (Blatchley); Tippecanoe (Cunningham); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Jefferson (J. M. Coulter); Franklin (Meyncke); Carroll; Gibson and Posey (Schneck); Cass (Hessler); Johnson (Barnes); "Evergreen" dunes, Lake and Porter (Cowles); Steuben (Bradner).

S. RADULA Nutt. Western Rough Golden Rod.

This western species was collected at Lake Maxinkuckee, Marshall County, by Dr. Robert Hessler. So far as I am able to discover it is the only record for the State.

S. RIGIDA L. Stiff or Hard-leaved Golden Rod.

In moist soils in prairies or at their borders. While nowhere abundant, it is reported from a number of counties. It is, perhaps, more abundant in the southern counties. The form is one of the handsomest of our golden rods and is quite variable.

The flowering season is from August to September.

Vigo (Blatchley); Noble (Van Gorder); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Jasper and Harrison (Barnes); Cass (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

S. OHIOENSIS Riddell. Ohio Golden Rod.

Found in moist soils in a few localities, but nowhere abundant. Flowers in August and September.

Clark (Baird and Taylor); Lake (Hill?); Tippecanoe (Coulter).

S. RIDDELLII Frank.

Rather common in wet places in the north-central and northern part of the State. Usually growing in prairies or open places.

Flowers in August and September.

Cass (Hessler); Tippecanoe (Hussey); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Hamilton (Wilson).

EUTHAMIA Nutt.**E. GRAMINIFOLIA (L.) Nutt. Bushy or Fragrant Golden Rod.**

(*Solidago lanceolata* L.)

Widely distributed and abundant in low grounds and marshes. Flowers from August until October.

Tippecanoe (Cunningham); Cass (Hessler); Jefferson (Barnes); Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Clark (Baird and Taylor); Franklin (Meyncke); Fayette (Hessler); Cedar Lake (Deam); Steuben (Bradner).

E. CAROLINIANA (L.) Greene.

(*Solidago tenuifolia* Pursh.)

Found in shaded places, usually in moist, sandy soil. Much more abundant in the southern part of the State.

Flowers in August and continues until the frosts.

Monroe and Vigo (Blatchley); Cass (Hessler); Jasper (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney).

BRACHYCHÆTA T. and G.

B. SPHACELATA (Raf.) Britton. False Golden Rod.
(*B. cordata* Torr. and Gray.)

Among the forms that have come into the flora from the south, the above is one of the most interesting. Its single reported station is at Clifty Falls in Jefferson County. The station abounds in exceptional forms, seeming for some reason to have served as a refuge for plants out of their usual range. The history of the plant is given in full in Proceedings of Indiana Academy of Science for 1895, pp. 189 and 190.

BOLTONIA L'Her.

B. ASTEROIDES (L.) L'Her. Aster-like Boltonia.

In low, open prairies and pastures, in moist, rich soil. Found chiefly in the southern part of the State, but not common in any of its stations.

Flowering season, from August through October.

Vigo (Blatchley); Jefferson (J. M. Coulter); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck).

SERIOCARPUS Nees.

S. LINIFOLIUS (L.) B. S. P. Narrow-leaved White-topped Aster.
(*S. solidagineus* Nees.)

Found in dry, sandy or gravelly soil, and on borders of prairies. Of relatively exceptional occurrence in the State, having been reported from but three counties.

Flowers from August to October.

Floyd (Clapp); Vigo (Blatchley); Kosciusko (Chipman).

ASTER L.

A. DIVARICATUS L. White-wood Aster.
(*A. corymbosus* Ait.)

In rather dry soil, usually found in thickets or thin woods. Not of frequent occurrence in the State.

Flowering season, September and October.

Only two localities definitely reported, though I have the form in several unlabelled collections.

Clark (Baird and Taylor); Noble (Van Gorder).

A. MACROPHYLLUS L. Large-leaved Aster.

Found in dry soil, in rather shaded places. Confined to the northern part of the State.

Flowering specimens collected August 8. Season probably extends through September.

Noble (Van Gorder); Round Lake (Deam); Steuben (Bradner).

A. SHORTII Hook.

A very showy aster, with violet-purple rays. In the northern part of the State it is very abundant in dry soil along roadsides and in fence corners. In the southern counties it is not so abundant and is ordinarily found in moist, shaded situations.

Flowers from August until late in October.

Monroe and Vigo (Blatchley); Jefferson (J. M. Coulter); Franklin (Meyneke); Clark (Baird and Taylor); Tippecanoe (Cunningham); Kosciusko (Coulter).

A. AZUREUS Lindl. Azure or Sky-blue Aster.

Open woods, but never abundant. Its range in the State is chiefly central and southern, not extending north of Cass and Tippecanoe.

It flowers from late in August until October.

Jefferson (Barnes); Vigo (Blatchley); Clark (Baird and Taylor); Tippecanoe (Barnes); Gibson and Posey (Schneck); Cass (Hessler).

A. CORDIFOLIUS L. Common Blue Wood Aster.

A very common and widely distributed species. It affects rather dry, coarse soils and is found in light woodlands, thickets and even along fence rows. A certain amount of shade seems necessary for its best development.

Flowering begins in July and continues through October.

Jefferson (Barnes); Tippecanoe (Coulter); Monroe and Vigo (Blatchley); Fayette (Hessler); Putnam (MacDougal); Noble (Van Gorder); Franklin (Meyneke); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Tippecanoe (Cunningham); Gibson and Posey (Schneck); Cass (Hessler); Steuben (Bradner).

A. DRUMMONDII Lindl. Drummond's Aster.

"Low, open pastures and prairies; frequent. Heckland; sides of Vandalia railway." These data are those of Mr. Blatchley, who first recorded the occurrence of this species in the State in his catalogue of the plants of Vigo County. No other station is known within our bounds.

A. SAGITTIFOLIUS Willd. Arrow-leaved Aster.

Common in dry, rich soils, usually found along the borders of fields and thickets. A very variable form.

Flowering season, from August through October.

Monroe and Vigo (Blatchley); Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Franklin (Meyneke); Clark (Baird and Taylor); Gibson and Posey (Schneck); Daviess (Clements); Kosciusko (Coulter); Steuben (Bradner).

A. UNDULATUS L. Wavy-leaf Aster.

Dry, open woods and thickets. An abundant form widely distributed.

Flowering season, from August until October.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Franklin (Meyneke); Putnam (MacDougal); Tippecanoe (Cunningham); Gibson and Posey (Schneck).

A. PATENS Ait. Late Purple Aster.

Found in dry soil in prairies or open ground, but nowhere abundant. Is found, however, in all parts of the State.

Flowers in September and October; occasionally in August in southern counties.

Vigo (Blatchley); Gibson and Posey (Schneck); Noble (Van Gorder); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Tippecanoe (Cunningham); Daviess (Clements).

A. NOVÆ-ANGLIÆ L.

A widely ranging, very beautiful species and also one of most easy recognition. In our area it is found in its best development in wet, rich ground, but it also occurs in scarcely less profusion on dry banks and along roadsides.

Flowering season, from August through October.

St. Joseph (Barnes); Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Fayette (Hessler); Tippecanoe (Cunningham); Franklin (Meyneke); Noble (Van Gorder); Jay, Delaware, Ran-

dolph, and Wayne (Phinney); Gibson and Posey (Schneck); Cass (Hessler); Hamilton and Marion (Wilson); Kosciusko (Coulter); Steuben (Bradner).

A. OBLONGIFOLIUS Nutt. Aromatic Aster.

In rich soils or on bluffs. Found in several counties, but abundant in none of its stations.

Flowering season, from August through October.

Jefferson (Barnes); Noble (Van Gorder); Tippecanoe (Conner and Laben); Clark (Baird and Taylor); Gibson and Posey (Schneck).

A. AMETHYSTINUS Nutt. Amethyst Aster.

In moist soil.

Flowers from September until October.

Steuben (Bradner).

A. PUNICEUS L. Purple stemmed Aster.

Found in moist, open woods and along the borders of marshes. In our area indicative of rich soil. An attractive form of easy recognition.

Flowering season, August and September.

Vigo (Blatchley); Fayette (Hessler); Franklin (Meyneke); Jefferson (J. M. Coulter); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson; Steuben (Bradner).

A. PRENANTHOIDES Muhl. Crooked-stemmed Aster.

Sparingly found in several counties, growing in moist, rich soils.

Flowering season, from late in August through October.

Fayette (Hessler); Franklin (Meyneke); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Tippecanoe (Barnes); Hamilton (Wilson).

A. LAEVIS L. Smooth Aster.

An abundant species in most of the counties in which it occurs. It is usually found in dry soil in prairies or open fields.

Flowering season, September and October, at least in the northern part of its range.

Jefferson and Benton (Barnes); Vigo (Blatchley); Daviess (Clements); Tippecanoe (Conner and Laben); Clark (Baird and Taylor); Cass (Hessler); Lake and Porter on "Evergreen dunes" (Cowles); Steuben (Bradner); Gibson.

A. JUNCEUS Ait. Rush Aster.

Reported, so far as I am able to discover, only from Clark County by Baird and Taylor. The station was a back-water slough, where the plant was found in abundance.

A. NOVI-BELGII L. New York Aster.

A swamp aster of limited distribution in our area. In Clark County it was found at the same station and associated with *A. junceus*.

The species was collected in flower August 3, which is the only fact bearing upon its flowering season.

Clark (Baird and Taylor); Noble (Barnes).

A. LONGIFOLIUS Lam. Long-leaved Aster.

This extreme northern form was collected by Dr. Charles R. Barnes in August, 1878, in Noble County, where it was growing in a peat bog. The herbarium specimens justify the reference, while the number of northern forms found in Noble County affords collateral evidence of the probability of its occurrence. It has not been reported since the above date. A citation of the occurrence of the form in Clark County is doubtless an error.

A. PTARMICOIDES (Nees) T. and G. Upland White Aster.

"Dry sands. Pine Station, Lake County." (E. J. Hill.) This was the only record for the State until 1894, when Messrs. Conner and Laben collected it at Happy Hollow, Tippecanoe County. A comparison of the Tippecanoe plant with the type specimens in the Gray herbarium verifies the original determination. At this station the plant was found on a dry ridge of fine gravel.

A. DUMOSUS L. Bushy Aster.

In dry, sandy or gravelly soil. Frequent along railways and roadsides, rarely found in shaded places.

Flowers in September and October.

Tippecanoe (Young); Monroe and Vigo (Blatchley); Noble (Van Gorder); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck).

A. SALICIFOLIUS Lam. Willow Aster.

Very common in moist soil in many parts of the State. It is especially abundant on bottom lands subject to an annual overflow, where it occurs associated with *A. paniculatus*.

Flowers in September and October.

Floyd (Clapp); Vigo (Blatchley); Jay, Delaware, Wayne, and Randolph (Phinney); Clark (Baird and Taylor); Putnam (MacDougal); Tippecanoe (Cunningham); Gibson and Posey (Schneck); Steuben (Bradner).

A. PANICULATUS Lam. Panicled White Aster.

Found largely associated with the preceding in similar soils.

Flowers in September and October.

Floyd (Clapp, 1837); Vigo (Blatchley); Clark (Baird and Taylor); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Daviess (Clements); Tippecanoe (Cunningham); Steuben (Bradner).

A. TRADESCANTI L. Michaelmas Daisy.

In low, open places, either wet or dry. In our area the form is more abundant in dry situations. Usually indicative of rich soil.

Flowers in September and October.

Monroe and Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Franklin (Meyncke); Tippecanoe (Cunningham); Gibson and Posey (Schneck); Steuben (Bradner).

A. FAXONI Porter.

(*A. polyphyllus* Willd.)

This form, occurring on moist cliffs in New England, New York and Pennsylvania, has obtained a footing in Lake County. Mr. Hill reports it from Whiting as growing in "grassy borders of low thickets" and also at East Chicago.

Flowering specimens were collected September 29, 1892.

A. ERICOIDES L. White Heath Aster. Frost-weed Aster.

Quite abundant in dry soil in open places, a favorite locality being abandoned fields. Rather more abundant in the southern counties.

Flowers from September until after the heaviest frosts.

Jefferson (Barnes); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Franklin (Meyncke); Clark (Baird and Taylor); Kosciusko (Coulter).

A. ERICOIDES PILOSUS (Willd.) Porter.*(A. ericoides villosus T. and G.)*

In similar localities as the preceding and as a rule more frequent. The extreme variability of *A. ericoides* and the complete series of intergrading forms leads to a doubt of the value of the numerous varieties listed under the species. In our area the varietal form given above is more common than the type.

Flowers from September until November.

Jefferson (J. M. Coulter); Franklin (Meyncke); Vigo (Blatchley); Putnam (MacDougal).

A. LATERIFLORUS (L.) Britton. Starved Aster. Calico Aster.*(A. diffusus Ait.)*

Abundant especially in the southern part of the State, not being reported north of Tippecanoe County. It is an extremely variable form, thriving best in dry, clayey soil, in open places. It is also frequently found in upland soils.

Flowers from August through October.

Floyd (Clapp); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Jefferson (Barnes); Tippecanoe (Cunningham); Fayette (Hessler); Vigo (Blatchley); Steuben (Bradner); Marion.

A. VIMINEUS Lam. Small White Aster.

In moist situations in a few counties of the State.

Grows in moist situations, more commonly in sandy or gravelly soil.

Flowers in August and September.

Clark (Baird and Taylor); Franklin (Meyncke); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney).

A. VIMINEUS FOLIOLOSUS (Ait.) Gray.

Found associated with the type form in Franklin County. Reported by Mr. O. M. Meyncke.

A. MULTIFLORUS Ait. Dense-flowered Aster.

Dry, sandy or barren soil in open places. Apparently more abundant in the southern counties of its range.

Flowers from September until in November.

Jefferson (J. M. Coulter); Franklin (Meyncke); Vigo (Blatchley); Clark (Baird and Taylor); Tippecanoe (Barnes).

ERIGERON L.

E. PULCHELLUS Michx. Robin's Plantain.*(E. bellidifolius Muhl.)*

Found on hillsides and banks in rather moist soil. Largely distributed throughout the State, but not especially abundant in any locality.

One of the earliest of the composites in flowering, which begins in April and extends through June.

Tippecanoe (Cunningham); Jefferson (Barnes); Vigo (Blatchley); Clark (Baird and Taylor); Franklin (Meyneke); Gibson and Posey (Schneck); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Fayette (Hessler); Steuben (Bradner); Lake (Hill).

E. PHILADELPHICUS L. Philadelphia Fleabane. Daisy Fleabane.

Generally distributed throughout the State and quite an abundant species in the southern counties. The characterization "locally rare" of Britton and Brown is not applicable in our range. It occurs in low, damp grounds in grassy areas.

Flowering season begins in April and continues through the summer.

Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyneke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Cunningham); Knox (Spillman); Hamilton and Marion (Wilson); Decatur (Ballard); Steuben (Bradner).

E. ANNUUS (L.) Pers. Daisy Fleabane. White-top.

Very abundant in fields, and often found in clover and timothy areas. Widely distributed throughout the State and ranked as a bad weed in many counties.

Flowers from May until in September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Franklin (Meyneke); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Fayette (Hessler); Knox (Spillman); Wabash (Jenkins); Hamilton and Marion (Wilson); Steuben (Bradner)

E. RAMOSUS (Walt.) B. S. P. Slender Daisy Fleabane. White-top.
(*E. strigosus* Muhl.)

Found in the same situations as the preceding, but more often invading woodlands. The form is not separated from *annuus* in many cases. Mr. Blatchley says: "This species and *E. annuus* are the most pernicious weeds with which the growers of timothy or clover have to contend."

Flowers from May until the late frosts.

Clark (Baird and Taylor); Franklin (Meyncke); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Monroe and Vigo (Blatchley); Fayette (Hessler); Knox (Spillman); Putnam (MacDougal); Hamilton and Marion (Wilson).

LEPTILON Raf.

L. CANADENSE (L.) Britton. Horse-weed. Butter-weed.
(*Erigeron Canadensis* L.)

Widely distributed and very common throughout the State, in many localities being an annoying weed. Found in fields and in open, waste places. In many parts of the State the abandonment of a field is the signal for the appearance of this species in great abundance.

Flowers from June until after heavy frosts.

Tippecanoe (Cunningham); Jefferson (Barnes); Clark (Baird and Taylor); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Jay, Delaware, Randolph and Wayne (Phinney); Daviess (Clements); Monroe and Vigo (Blatchley); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

L. DIVARICATUM (Michx.) Raf. Low Horse-weed.
(*Erigeron divaricatus* Michx)

Reported only from the extreme southern part of the State where it is occasionally found on the sandy banks of streams.

Flowers from June through September.

Jefferson (J. M. Coulter); Gibson and Posey (Schneck).

DOELLINGERIA Nees.

D. UMBELLATA (Mill.) Nees. Tall, White Aster. Flat-topped Aster.
(*Aster umbellatus* Mill.)

The local range of this species has been considerably extended within the past few years. It is found in moist, even wet soil, exceptionally reaching a height of ten feet.

Its flowering season begins in July and probably continues until the frosts.

Jefferson (Barnes); Clark (Baird and Taylor); Jay (Phinney); Lake (Hill); Cass and Marshall (Hessler); Wabash (Jenkins); Steuben (Bradner).

IONACTIS Greene.

I. LINARIIFOLIUS (L.) Greene. Double-Bristled Aster. Stiff-leaved Aster.

(*Aster linariifolius* Hook.)

Found in dry, sandy soils in a few counties of the State. The habit of growth of the species is such as to lead to its easy recognition.

Flowering season from July through September.

Vigo and Lake (Blatchley); Cass (Hessler); Putnam (MacDougal).

PLUCHEA Cass.

P. CAMPHORATA (L.) DC. Spicy Fleabane.

This salt-marsh form is found on river banks in the extreme southern counties of the State.

Jefferson (Barnes); Gibson and Posey (Schneck).

P. PETIOLATA Cass. Inland Marsh Fleabane.

(*P. fetida* DC.)

In southern Indiana, in moist soil, often in woods.

Flowers from August until October.

Jefferson and Gibson.

ANTENNARIA Gaertn.

A. PLANTAGINIFOLIA (L.) Richards. Plantain-leaf Everlasting. Mouse Ear. White Plantain.

Abundantly distributed throughout our area, usually growing on dry slopes, or in dry, open woods. It very often completely covers patches of a fourth of an acre or more.

Flowering season from early April through June.

Jefferson (Barnes); Putnam (MacDougal); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Tippecanoe and Kosciusko (Coulter); Fayette (Hessler); Daviess (Clements); Hamilton (Wilson); Steuben (Bradner).

ANAPHALIS DC.

A. MARGARITACEA (L.) Benth. and Hook. Pearly Everlasting.
(*Antennaria margaritacea* Hook.)

In dry soil, in a few counties of the State. The range is probably greater than reported.

Flowers much later than the preceding, from July through September.

Gibson and Posey (Schneck); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Tippecanoe (Cunningham); Hamilton and Marion (Wilson).

GNAPHALIUM L.

G. OBTUSIFOLIUM L. Common Everlasting.
(*G. polycephalum* Michx.)

Throughout the State in dry, open places and also in dry woods.

Flowers in August and September.

Daviess (Clements); Tippecanoe (Wright); Clark (Baird and Taylor); Franklin (Meyneke); Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Monroe and Vigo (Blatchley); Fayette (Hessler); Knox (Spillman); Steuben (Bradner).

G. ULIGINOSUM L. Low Cud-weed.

Found in moist localities and of definite report from but a few counties.

Flowering season from July through September.

Jefferson (Barnes); Clark (Baird and Taylor); Noble (Van Gorder); Montgomery; Steuben (Bradner); Lake (Hill).

G. PURPUREUM L. Purplish Cud-weed.

In dry soil, chiefly in open woods. Well distributed, but never especially abundant.

Flowers from early in May, through the summer.

Jefferson (Barnes); Putnam and Union (MacDougal); Monroe and Vigo (Blatchley); Clark (Baird and Taylor); Franklin (Meyneke); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Floyd (Barnes); Fayette (Hessler).

INULA L.

I. HELENIUM L. Elecampane.

In many counties of the State in old fields, along roadsides and on dry banks. More abundant in the northern counties of its range.

Flowering season from June until late in August.

Tippecanoe (Cunningham); Jefferson (J. M. Coulter); Putnam (MacDougal); Franklin (Meyncke); Clark (Baird and Taylor); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Dearborn (Collins); Monroe and Vigo (Blatchley); Fayette (Hessler); Decatur and Shelby (Ballard); Round Lake (Deam); Hamilton and Marion (Wilson); Steuben (Bradner).

POLYMNIA L.

P. UVEDALIA L. Large flowered Leaf-cup.

In rich, shaded soils in various counties, chiefly southern. It is never abundant in any of its Indiana stations.

Flowering season, July and August.

Franklin (Meyncke); Clark (Baird and Taylor); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Kosciusko (Chipman); Crawford (Blatchley).

P. CANADENSIS L. Small flowered Leaf-cup.

Of more general distribution than the preceding, but only abundant in exceptional stations. Its favorite location is in deep and shaded ravines in rich moist soil. A plant of very disagreeable odor.

Flowering season, June to September.

Jefferson (J. M. Coulter); Tippecanoe (Cunningham); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Franklin (Meyncke); Noble (Van Gorder); Putnam (MacDougal).

SILPHIUM L.

S. PERFOLIATUM L. Cup-plant. Indian cup.

Found in moist, rich soils, chiefly along the banks of streams. More abundant in the northern counties of its range.

Flowering season, July and August.

Tippecanoe (Cunningham); Kosciusko (Coulter); Putnam (MacDougal); Gibson and Posey (Schneck); Franklin (Meyncke); Jay, Delaware, Randolph, and Wayne (Phinney); Monroe and Vigo (Blatchley); Fayette (Hessler); Jefferson; Lake; Marion; Hamilton (Wilson).

S. INTEGRIFOLIUM Michx. Entire-leafed Rosin-weed.

Found in prairies and open fields in rather damp soil. Its more abundant distribution occurs in the northern part of its range.

Flowering season, August and September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Cass (Hessler); Laporte (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck).

S. TRIFOLIATUM L. Whorled Rosin-weed.

In rich, damp woods or about the shaded margins of lakes. Chiefly northern in its reported range.

Flowers from the middle of July until in August.

Laporte (Barnes); Noble (Van Gorder); Round Lake (Deam); Clark (Baird and Taylor); Jefferson (Barnes); Cass (Hessler).

S. LACINIATUM L. Compass-plant. Pilot-weed.

In open or prairie regions, most frequently in rich, moist soils. Abundant in the northern counties of its range, much less so in the southern counties.

Flowering season from July through September.

Tippecanoe (Cunningham); Cass (Hessler); Jasper (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Noble (Van Gorder); Elkhart (Barnes).

S. TEREBINTHINACEUM Jacq. Prairie-dock.

Found in several counties of the State in prairies and dry woods, attaining its best development in sandy soils. Very much more abundant in the northern counties of its range.

Flowering season July until the middle of October.

Vigo (Blatchley); Gibson and Posey (Schneck); Jay, Delaware, Randolph and Wayne (Phinney); Elkhart (Barnes); Kosciusko (Coulter); Tippecanoe (Wright); Hamilton (Wilson); Steuben (Bradner).

PARTHENIUM L.**P. INTEGRIFOLIUM L. American Fever-few. Prairie Dock.**

In dry, open places, reaching its best development in sandy soil. The chief distribution is in the southern counties of the State, not extending farther north than Laporte and Cass counties.

Flowering season from May until September.

Floyd (Clapp); Laporte (Barnes); Clark (Baird and Taylor); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Cass (Hessler); Vigo (Blatchley).

HELIOPSIS Pers.

H. HELIANTHOIDES (L.) B. S. P. False Sun-flower. Smooth Ox-eye.
(*H. levis* Pers.)

Found in dry soils in considerable abundance throughout the State. Fence-rows and thickets apparently furnish the most suitable stations.

Flowering season, July and August.

Daviess (Clements); Jefferson (Barnes); Clark (Baird and Taylor); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Monroe and Vigo (Blatchley); Tippecanoe (Coulter); Fayette (Hessler).

H. SCABRA Dunal. Rough Ox-eye.

A more abundant form than the preceding, occurring in similar localities. While not reported from the extreme northern counties it is doubtless to be found throughout our area.

Flowering season, July and August.

Monroe and Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Jefferson (J. M. Coulter); Fayette (Hessler); Tippecanoe (Coulter).

ECLIPTA L.

E. ALBA (L.) Hassk.

Along streams and borders of ponds in moist or even wet soils. Quite widely distributed, and in favorable localities very abundant.

Flowering season from July until the frosts.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Johnson (Barnes); Tippecanoe (Cunningham); Hamilton and Marion (Wilson).

RUDBECKIA L.

R. TRILOBA L. Small-flowered Cone Flower.

Borders of streams and damp, low ground throughout the State. The great range of variation in the foliage leaf, as well as the showy floral heads, render the plant of easy recognition.

Flowering season from June through September.

Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney);

Franklin (Meyncke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Putnam (MacDougal); Tippecanoe (Cunningham); Hamilton and Marion (Wilson).

R. SUBTOMENTOSA Pursh. Sweet Cone Flower.

The distribution of this form is such as to warrant the belief that it is to be found in all parts of the State, although there are definite reports from but a few counties. It is found on prairies or upon the banks of streams.

Flowering season, July to September.

Tippecanoe (Cunningham); Cass (Hessler); Jasper (Barnes); Gibson and Posey (Schneck); Knox (Spillman); Elkhart (Barnes).

R. HIRTA L. Black-eyed Susan. Meadow Cone Flower. Nigger-head.

In all parts of the State, being found in open places in either dry or damp soils. It is perhaps more abundant in dry soils. It varies widely in habit even in the same situation. Prof. Blatchley says: "Appears to be both an annual and biennial; in the former case lower and more simple stemmed and blooming in late autumn; as a biennial, stouter, more branched and blossoming early."

Flowers from early in June until the late frosts.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Daviess (Clements); Clark (Baird and Taylor); Jay Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Noble (Van Gorder); Gibson and Posey (Schneck); Vermillion (Wright); Tippecanoe (Cunningham); Putnam (MacDougal); Kosciusko (Coulter); Hamilton (Wilson); Steuben (Blatchley).

R. FULGIDA Ait. Orange Cone Flower.

Reported only from the eastern part of the State by Dr. Phinney. The form is so characteristic as to scarcely admit of error in its determination. It is found usually in dry soil.

Flowers in August and September.

Jay, Delaware, Randolph, and Wayne (Phinney).

R. SPECIOSA Wenderoth. Show-Cone Flower.

Found in moist soils in a few counties of the State.

Flowers in our range late in August and in September.

Jefferson (J. M. Coulter); Fayette (Hessler); Kosciusko (Coulter).

R. LACINIATA L. Tall Cone Flower.

Found in moist, shaded localities in many counties. Usually abundant in the stations in which it occurs.

Flowering begins early in July and continues through September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Harrison (Barnes); Monroe and Vigo (Blatchley); Owen and Putnam (MacDougal); Dearborn (Collins); Clark (Baird and Taylor); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Noble (Van Gorder); Franklin (Meynecke); Cedar Lake (Deam); Hamilton (Wilson); Fayette and Cass (Hessler).

RATIBIDA Raf.**R. PINNATA (Vent.) Barnhart.** Gray-headed Cone Flower.

(*Lepachys pinnata* T. and G.)

Found in many counties of the State, but nowhere abundant. Frequents dry prairies and railway embankments.

Flowering season, June to September.

Vigo (Blatchley); Carroll (Coulter); Tippecanoe (Cunningham); Kosciusko (Coulter); Cass (Hessler); Laporte (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Hamilton (Wilson); Steuben (Bradner).

BRAUNERIA Neck.**B. PURPUREA (L.) Britton.** Purple Cone Flower.

(*Echinacea purpurea* Moench.)

Found in various parts of the State, but never in great abundance. It reaches its best development in moist, rich soil, but is also often found in dry and sandy locations.

Flowering season from July until the frosts.

Tippecanoe (Cunningham); Cass (Hessler); Harrison and Floyd (Barnes); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meynecke); Vigo (Blatchley).

B. PALLIDA (Nutt.) Britton. Pale-purple Cone Flower.

(*Echinacea angustifolia* DC.)

Confined to the extreme northern counties of the State, where it is found in dry, sandy soil in open places. Even in the localities cited the species is quite rare.

Flowering season, July through September.

Lake (Hill); Laporte.

HELIANTHUS L.

H. ANNUUS L. Common Sunflower.

This familiar form has escaped from civilization in many parts of the State. In its wild state it is much smaller than under cultivation. The species has considerable economic value, and is being quite largely cultivated in some parts of the country. "Its flowers yield honey and a yellow dye; its leaves fodder; its seeds an oil and food; and its stalks a textile fibre" (Britton and Brown). Locally it is somewhat largely cultivated for the oil derived from its seeds.

Flowering from early in July through the summer.

Vigo and Monroe (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Putnam (MacDougal); Lake (Hill); Hamilton and Marion (Wilson); Steuben (Bradner).

H. SCABERRIMUS Ell. Stiff Sunflower.

(*H. rigidus* Desf.)

This western form seems to have obtained lodgment in the eastern counties. It doubtless first appeared as a migrant, and has since maintained itself, though spreading but slightly. Open places in dry soil.

Flowers in our range late in August; probably continuing through September.

Jay, Delaware, Randolph, and Wayne (Phinney).

H. OCCIDENTALIS Riddell. Few-leaved Sunflower.

Found sparingly in a few counties growing in dry, open places on prairies.

Flowering season, August and September.

Cass (Hessler); St. Joseph (Barnes); Vigo (Blatchley); Steuben (Bradner).

H. MICROCEPHALUS T. and G. Small Wood Sunflower.

(*H. parviflorus* Bernh.)

Well distributed through the State, and finding its favorite location in moist woods or upon the shaded banks of streams. It also occurs in moist prairies. Apparently more abundant in the southern part of its range.

Flowers from July through September.

Johnson (Barnes); Gibson and Posey (Schneck); Jay, Delaware, Randolph and Wayne (Phinney); Jefferson (J. M. Coulter); Franklin (Meyncke); Vigo and Monroe (Blatchley); Fayette (Hessler).

H. GIGANTEUS L. Tall or Giant Sunflower.

In swamps and wet meadows in many counties. Rather common in the localities in which it occurs.

Flowering season from middle of August until October.

Laporte (Barnes); Clark (Baird and Taylor); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Hamilton and Marion (Wilson); Vigo (Blatchley); Steuben (Bradner).

H. GROSSE-SERRATUS Martens. Saw-toothed Sunflower.

Dry soil in prairies and along roadsides and in fence-rows. In suitable locations it becomes very tall, Mr. Blatchley reporting a specimen twelve feet high.

Flowering season, August and September.

Jasper (Barnes); Vigo (Blatchley); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Marion (Wilson).

H. DIVARICATUS L. Rough or Woodland Sunflower.

A characteristic form of easy recognition found in considerable abundance in many counties. It is most abundant in dry, light woods, although often found along the banks of streams. Upper leaves frequently in whorls of three.

Flowering season, July through September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Cass (Hessler); Daviess (Clements); Floyd (Clapp); St. Joseph (Barnes); Clark (Baird and Taylor); Franklin (Meyncke); Noble (Van Gorder); Vermillion (Wright); Lake; Vigo (Blatchley); Steuben (Bradner).

H. MOLLIS Lam. Hairy Sunflower.

Found in dry, sandy or sterile soil in various parts of the State. Easily recognized by the pubescence of the leaves, although extremely variable in our area. The character and amount of the pubescence varies in the individual plant in different stages of its growth.

Flowers August and September.

Harrison and Jasper (Barnes); Vigo (Blatchley); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Vermillion.

H. DORONICOIDES Lam. Oblong-leaved Sunflower.

An abundant form in several parts of the State. Indicative of dry soil.

Flowering season, August and September.

Jefferson (Barnes); Monroe (Blatchley); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Putnam (MacDougal).

H. DECAPETALUS L. Thin-leaved or Wild Sunflower.

One of the most abundant and widely distributed species of the genus. It is found along streams or in damp woods, reaching its greatest profusion and largest size in black loam soils. Usually as indicative of rich soil as of moisture.

Flowers from July through September.

Monroe (Blatchley); Daviess (Clements); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Tippecanoe (Cunningham); Kosciusko (Coulter); Hamilton (Wilson); Carroll.

H. TRACHELIIFOLIUS Mill.

Found in dry soil along fence-rows or roadsides. Definitely reported from but few counties, though probably of general occurrence.

Flowering season August and September.

Jefferson (Barnes); Tippecanoe (Skinner); Vigo (Blatchley); Carroll.

H. STRUMOSUS L. Pale-leaved Wood Sunflower.

Reported from but few counties, but abundant where found in dry, coarse soil. In Tippecanoe found most abundantly on roadsides and in dry woods.

Flowering season July until October.

Jay, Delaware, Randolph, and Wayne (Phinney); Tippecanoe (Wright); Hamilton and Marion (Wilson); Carroll.

H. HIRSUTUS Raf. Stiff-haired Sunflower.

Well distributed throughout the State, especially in southern and central parts. Not reported north of Tippecanoe County. In dry soils, chiefly in woods or at their border. The densely hirsute stem furnishes a means of ready recognition.

Flowering season, July to October.

Harrison (Barnes); Vigo (Blatchley); Daviess (Clements); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Jasper.

H. LÆTIFLORUS Pers. Showy Sunflower.

A widely distributed and common form. Indicative of dry soil, and usually found in prairies or open barrens. Found also in thickets and the border of woods, but in much less profusion in such localities.

Flowering season July through September.

Jefferson and Jasper (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Dearborn (Collins); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Tippecanoe (Cunningham); Steuben (Bradner); Jasper.

H. TOMENTOSUS Michx. Woolly Sunflower.

Reported from two counties in different parts of the State. The species is eastern in its mass distribution, but has been reported from Illinois. The species is admitted upon rather scant specimens which seem to justify the reference.

Collected in flower on the fifteenth of August.

Clark (Baird and Taylor); Steuben (Bradner).

H. TUBEROSUS L. Jerusalem Artichoke. Earth Apple.

This species occurs in the southern part of the State in considerable abundance in moist, alluvial soils. Less common northward. Extensively grown in some places for its edible tubers.

Flowers in September and October.

Vigo (Blatchley); Franklin (Meyncke); Gibson and Posey (Schneck); Cass (Coulter); Hamilton and Marion (Wilson); Steuben (Bradner).

VERBESINA L.**V. HELIANTHOIDES Michx.**

More abundant in the northern than in the southern counties, though found in fair abundance in all parts of the State. Found in dry soil on prairies or in thickets.

Flowers in June and July.

Kosciusko (Coulter); Tippecanoe (Wright); Franklin (Meyncke); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Vigo (Blatchley); Marion.

V. ALTERNIFOLIA (L.) Britton.*(Actinomeris squarrosa Nutt.)*

Distributed throughout the State occurring in low, moist, rich soils preferring slightly shaded locations. In our region the stem is always decidedly winged, furnishing an easy means of recognition. Much more abundant than the preceding. In some localities the dominant form over large areas.

Flowers in August and September.

Tippecanoe and Montgomery (Cunningham); Kosciusko (Coulter); Jefferson (Barnes); Union and Putnam (MacDougall); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Monroe and Vigo (Blatchley); Fayette (Hessler).

COREOPSIS L.**C. PALMATA Nutt. Stiff Tickseed.**

Confined to the northern part of the State, where it occurs rather abundantly in dry, sandy soil. Not reported south of Cass County.

Flowers in June and July.

Cass (Hessler); St. Joseph and Laporte (Barnes); Lake (Hill).

C. LANCEOLATA L. Lance-leaved Tickseed.

Found in dry, sandy soil usually on ridges or knolls in a few counties. Never abundant.

Flowers as early as May, and collected as late as August.

Vigo (Blatchley); Lake; Marion; Steuben (Bradner).

C. AURICULATA L. Lobed Tickseed.

Found chiefly in the southern part of the State in damp woods or along streams. Definitely reported from only two counties, but found in most of the river counties.

Flowering specimens collected in May.

Clark (Baird and Taylor); Steuben (Bradner).

C. TRIPTERIS L. Tall Tickseed.

Of wider distribution and greater abundance than any other species of the genus. It occurs most frequently in damp woods and thickets. It also grows along railways and roadsides in which situation it occasionally reaches a height of ten feet. In denser shades it is a much shorter, bushier form.

Flowers from July to October.

Tippecanoe (Cunningham); Cass (Hessler); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (Barnes); Gibson and Posey (Schneck); Noble (Van Gorder); Clark (Baird and Taylor); Kosciusko (Coulter); Franklin (Meyncke); Vigo (Blatchley); Hamilton and Marion (Wilson); Steuben (Bradner).

BIDENS L.

B. LEVIS (L.) B. S. P. Larger Bur-marigold.

(*B. chrysanthemoides* Michx.)

In swamps or low, wet alluvial soils. Widely distributed through the State, and abundant in the stations in which it occurs.

Flowers from August until in November.

Jefferson (Barnes); Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Marion (Moffatt).

B. CERNUA L. Smaller Bur-marigold.

Common in wet soils and shallow ditches throughout the State.

Flowers from July until late in October.

Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Tippecanoe (Cunningham); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner); Jefferson.

B. CONNATA Muhl. Swamp Beggar-ticks.

Very abundant in marshes and wet soils, sometimes occupying almost exclusively tracts of acres in low, wet bottom lands.

Flowers in August and continues its season until October.

Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Fayette (Hessler); Daviess (Clements); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Hamilton and Marion (Wilson); Steuben (Bradner).

B. DISCOIDEA (T. and G.) Britton.

(*Coreopsis discoidea* T. and G.)

Found in Indiana only in the cypress swamps, and there of exceptional occurrence.

Flowering specimens collected July 28th.

Gibson.

B. FRONDOSA L. Common Beggar-ticks.

In moist soil, and a very annoying weed, in waste fields and in fence corners of cultivated fields. Wherever it obtains a foothold it multiplies rapidly, often occupying almost exclusively large areas.

Flowers from July through September.

Jefferson (J. M. Coulter); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Daviess (Clements); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Tippecanoe (Cunningham); Kosciusko (Coulter); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

B. BIPINNATA L. Spanish Needles.

Abundant in almost every situation. Often a troublesome weed in cultivated fields. With us it reaches its fullest development in size and numbers in moist soil.

Flowering from July through September.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Cunningham); Knox (Spillman); Hamilton and Marion (Wilson).

B. TRICHOSPERMA (Michx.) Britton. Tall Tickseed Sunflower.

(*Coreopsis trichosperma* Michx.)

In swamps and wet lowlands throughout the State. Nowhere especially abundant.

Flowering season, August and September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Monroe (Blatchley); Jefferson (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke); Round Lake (Deam); Lake and Porter (Hill); Hamilton and Marion (Wilson); Steuben (Bradner).

B. TRICHOSPERMA TENUILOBA (Gray) Britton.

(*Coreopsis trichosperma tenuiloba* Gr.)

The prevailing form in the dune region of the southern shore of Lake Michigan.

Flowering season, same as preceding.

Lake and Porter (Hill).

B. ARISTOSA (Michx.) Britton. Western Tickseed Sunflower.
(*Coreopsis aristosa* Michx.)

Not uncommon in wet soils in many counties of the State. Somewhat more abundant in the northern part of its range.

Flowers in August and September.

Gibson and Posey (Schneck); Noble (Van Gorder); Montgomery (Hussey); Fayette (Hessler); Knox (Spillman); Tippecanoe (Coulter); Hamilton and Marion (Wilson); Steuben (Bradner).

B. BECKII Torrey. Water Marigold.

First reported as occurring in the State by Mr. W. W. Chipman. The following year an additional station was detected by Mr. C. C. Deam. Where the plant occurs at all, it is found in considerable abundance. It will probably be found to have additional stations especially in the region of the smaller lakes.

Flowers in August and September.

Kosciusko (Chipman); Round Lake (Deam); Steuben (Bradner); Marshall (Hessler).

HYMENOPAPPUS L'Her.

H. CAROLINENSIS (Lam.) Porter.

(*H. scabiosus* L'Her.)

The only record in the State is the following: "Dry, sandy hillsides; rare. Taken only on the hillside northeast of the Seventh Street bridge across Lost Creek, May 31, 1890." This is one of a number of forms added to the State flora by Prof. W. S. Blatchley, who has lost no opportunity to increase the knowledge of the natural history of the State.

Vigo (Blatchley).

HELENIUM L.

H. AUTUMNALE L. Sneezeweed.

In swamps and low, wet grounds throughout the State. Abundant wherever found.

Flowering season, August to October.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Daviess (Clements); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Tippecanoe (Cunningham); Putnam (MacDougal); Hamilton and Marion (Wilson).

H. NUDIFLORUM Nutt.

Less widely distributed and much less frequent than the preceding. It is usually found in moist places, but thrives well in dry soil if rich. It is confined to the central and southern counties.

Flowering begins in June and continues until the frosts.

Vigo (Blatchley); Monroe (Dudley); Jay, Delaware, Randolph, and Wayne (Phinney); Gibson and Posey (Schneck); Marion and Jefferson.

DYSODIA Cav.**D. PAPPOSA (Vent.) A. S. Hitchcock. Fetid Marigold. Yellow Dog-fennel.**

(*D. chrysanthemoides* Lag.)

Widely distributed and abundant throughout the State. Many roadsides are for miles covered with this species. In this situation it prefers the gravelly soils. Where there is more moisture it affects sandy banks. It is in many places apparently replacing the common dog fennel, *Anthemis Cotula*. Characterized by its strong, unpleasant odor.

Flowers from July through October.

Knox (Spillman); Kosciusko and Tippecanoe (Coulter); Cass (Hessler); Harrison, Jennings, and Johnson (Barnes); Putnam and Union (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Clark (Baird and Taylor); Franklin (Meyncke); Marion; Jefferson; Monroe and Vigo (Blatchley); Fayette (Hessler); Hamilton (Wilson).

ACHILLEA L.**A. MILLEFOLIUM L. Yarrow.**

Common throughout the State, being found in greatest abundance along roadsides, and in old fields and meadows. It does well by the side of a road in hard dry soil, and dust-laden air, and thrives equally in moist soil at the edge of a pond or small lake.

Commencing to flower in June, it continues until the heaviest frosts.

Jefferson (Barnes); Monroe and Vigo (Blatchley); Fayette (Hessler); Daviess (Clements); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Dearborn (Collins); Franklin (Meyncke); Gibson and Posey (Schneck); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Cunningham); Kosciusko (Coulter); Vermillion (Wright); Knox (Spillman); Decatur and Shelby (Ballard); Hamilton and Marion (Wilson); Steuben (Bradner).

ANTHEMIS L.

A. COTULA L. Common Dog-fennel. Mayweed.

Very abundant, and very annoying, in almost every part of the State. In dry soil along roadsides or in waste places. Easily recognized by its finely dissected leaves and disagreeable odor.

Flowers continuously from June until the heavy frosts.

Monroe and Vigo (Blatchley); Fayette (Hessler); Clark (Baird and Taylor); Dearborn (Collins); Jay, Delaware, Randolph and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Putnam (MacDougal); Tippecanoe (Cunningham); Vermillion (Wright); Kosciusko (Coulter); Hamilton and Marion (Wilson); Steuben (Bradner).

A. ARVENSIS L.

Adventive from Europe. Seemingly established in a few localities.

Flowers July to September.

Monroe (Blatchley); Clark (Baird and Taylor).

CHRYSANTHEMUM L.

C. LEUCANTHEMUM L. Ox-eyed Daisy. Margarine. White Daisy.

A troublesome weed in some of the southern counties, but becoming much less common in the northern part of the State. Found in dry soils in waste places, also invading pastures and meadows. Very difficult to eradicate when it has obtained a foothold. Spread in some instances because of the use of the flower in decoration, large patches having been noted as springing up at the place where the wilted flowers were thrown. A very handsome form.

Flowers from May through October.

Daviess (Clements); Jefferson (Barnes); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Dearborn (Collins); Putnam (MacDougal); Kosciusko (Chipman); Hamilton (Wilson); Floyd and Monroe; Marion (Moffatt).

C. PARTHENIUM (L.) Pers. Common Feverfew.

Confined to the southern counties where it is found sparingly in waste places adjoining old dwellings. It seems able to maintain itself, but does not spread to any extent.

Flowers in June and July.

Gibson and Posey (Schneck); Clark (Baird and Taylor).

TANACETUM L.

T. VULGARE L. Tansy.

Established in almost every part of the State, and becoming more and more common. Chiefly along roadways or near abandoned gardens.

Flowers from July through September.

Fayette (Hessler); Steuben (Bradner); Daviess (Clements); Clark (Baird and Taylor); Jay, Delaware, Randolph, and Wayne (Phinney); Franklin (Meyncke); Gibson and Posey (Schneck); Jefferson (J. M. Coulter); Noble (Van Gorder); Tippecanoe (Cunningham); Putnam (MacDougal); Hamilton and Marion (Wilson).

ARTEMISIA L.

A. CAUDATA Michx. Tall or Wild Wormwood.

Confined to sandy soil in the northern part of the State. A character plant of the upper beach stretches in Lake and Porter counties. Only one report of its occurrence inland, in which case the station is on the sandy beach of an extinct lake.

Flowers from July until October.

Fulton and Cass (Hessler); Lake (Hill); Porter (Cowles).

A. CANADENSIS Michx. Canada Wormwood.

Found associated with the preceding upon the upper beach of the shores of Lake Michigan.

Flowering season as in the preceding.

Lake (Hill); Porter (Cowles).

A. ABSINTHIUM L. Common Wormwood.

Very occasionally established in waste places and barely maintaining itself from year to year.

Flowers July to October.

Gibson and Posey (Schneck); Fayette (Hessler); Steuben (Bradner).

A. ABBOTANUM L.

On the bank of the Ohio River, where it seems to have become firmly established.

Collected in flower the 8th of August.

Jefferson (J. M. Coulter).

A. ANNUA L.

In the southwestern counties, where it is quite abundant in dry waste places.

Flowering July and August.

Gibson.

A. BIENNIS Willd.

A coarse weed with a disagreeable odor somewhat common in dry, sandy soil in the southern part of the State, less so in the northern counties.

Flowers in August and September.

Jefferson (J. M. Coulter); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Fayette (Hessler).

ERECHTITES Raf.**E. HIERACIFOLIA (L.) Raf. Fire Weed.**

Borders of woods and thickets, especially abundant where the soil has been burned over. It is found in rich, rather moist, soils.

Flowers from July through September.

Tippecanoe (Cunningham); Jefferson (Barnes); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Dearborn (Collins); Cedar Lake (Deam); Fayette (Hessler); Steuben (Bradner); Montgomery (Coulter).

MESADENIA Raf.**M. RENIFORMIS (Muhl.) Raf. Great Indian Plantain.**

(*Cacalia reniformis* Muhl.)

Found in rich, moist soils. Confined so far as reports go, to the southern counties of the State.

Flowering season July through September.

Jefferson (J. M. Coulter); Clark (Baird and Taylor); Monroe and Vigo (Blatchley); Putnam (MacDougal); Fayette (Hessler); Hamilton (Wilson); Marion (Moffatt).

M. ATRIPLICIFOLIA (L.) Raf. Pale Indian Plantain.*(Cacalia atriplicifolia L.)*

In woods and on shaded hillsides in many counties of the State, but nowhere especially abundant.

Flowers from July through September.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson (Barnes); Cass and Fayette (Hessler); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph and Wayne (Phinney); Franklin (Meyncke); Vigo (Blatchley); Steuben (Bradner); Monroe; Lake (Hill).

M. TUBEROSA Nutt.

Confined to the northern counties of the State, where it occurs sparingly in marshes and wet places. Its range is doubtless much larger than indicated by the reports.

Flowering season, June to August.

Tippecanoe (Cunningham); Cass (Hessler); Laporte (Barnes); Lake and St. Joseph.

SYNOSMA Raf.**S. SUAVEOLENS (L.) Raf. Sweet-scented Indian Plantain.***(Cacalia suaveolens L.)*

In moist woods or along streams, not extending farther north than Tippecanoe County.

Flowers in August and September.

Tippecanoe (Cunningham); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Wabash (Jenkins); Porter and Marion.

SENECIO L.**S. OBOVATUS Muhl. Round-leaf Squaw Weed.***(S. aureus obovatus T. and G.)*

In moist soils and on banks of streams. Not especially common, but found in all parts of the State.

Flowers from April through June.

Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Putnam (MacDougal).

S. AUREUS L. Golden Ragwort. Swamp Squaw Weed.

One of the most common of our early composites. Found in marshes, on banks of streams and in damp ravines. Of wide distribution and quite common.

Flowers in April, continuing until July.

Tippecanoe (Cunningham); Daviess (Clements); Jefferson and Clark (Barnes); Monroe (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Franklin (Meyncke); Knox (Spillman); Fayette; Hamilton (Wilson); Steuben (Bradner).

S. PALUSTRIS (L.) Hook. Pale Ragwort.

In swamps and wet places in a few counties, chiefly southern and western. The species has evidently entered the flora from the west.

Flowers in June and July.

Clay and Putnam (MacDougal).

S. LOBATUS Pers. Butterweed.

The first record of this species was made by Mr. Blatchley, whose special studies of the composites have added much to our knowledge of the family in the State. Found growing at margin of ponds.

Collected in flower May 21st.

Vigo (Blatchley); Knox (Spillman).

ARCTIUM L.**A. LAPPA L. Burdock.**

Widely distributed and very abundant in all parts of the State. It is very common in abandoned fields and dooryards, and is difficult to exterminate.

Flowers from July through the frosts.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Franklin (Meyncke); Dearborn (Collins); Decatur and Shelby (Ballard); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

CARDUUS L.

C. LANCEOLATUS L. Common Thistle.*(Oniscus lanceolatus Willd.)*

The most abundant and widely distributed form of the genus. Occurs everywhere, but especially abundant in waste or abandoned lands and along roadsides.

Flowering season, July until frosts.

Tippecanoe (Cunningham); Jefferson (Barnes); Putnam (MacDougal); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Franklin (Meyncke); Dearborn (Collins); Daviess (Clements); Decatur and Shelby (Ballard); Fayette (Hessler); Hamilton and Marion (Wilson); Steuben (Bradner).

C. ALTISSIMUS L. Tall or Roadside Thistle.*(Oniscus altissimus Willd.)*

Widely distributed throughout the State, occurring in locations similar to the preceding species. It is somewhat more abundant in the northern counties of the State.

Flowers in August and September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Daviess (Clements); Vigo (Blatchley); Gibson and Posey (Schneck); Jay, Delaware, Randolph, and Wayne (Phinney); Jefferson (J. M. Coulter); Clark (Baird and Taylor); Franklin (Meyncke); Fayette (Hessler); Hamilton (Wilson); Steuben (Bradner); Marion (Moffatt).

C. DISCOLOR (Muhl.) Nutt. Field Thistle.*(Oniscus altissimus discolor Gray.)*

In similar situations, though less common and less widely distributed.

Flowers from August until November.

Elkhart (Barnes); Vigo (Blatchley); Putnam (MacDougal); Gibson and Posey (Schneck); Daviess (Clements); Fayette (Hessler); Steuben (Bradner).

C. VIRGINIANUS L.*(Oniscus virginianus Pursh.)*

In dry, shaded localities in the eastern counties of the State. Evidently has entered the flora from the east.

Flowers in May continuing through September.

Jay, Delaware, Randolph, and Wayne (Phinney).

C. PITCHERI (Torr.) Porter.*(Onicus Pitcheri Torrey.)*

Found only in the sandy soils in the northern counties. One of the prominent members of the upper beach flora. Not reported inland.

Flowers July and August.

Lake (Hill); Porter (Cowles).

C. UNDULATUS Nutt. Wavy-leaved Thistle.*(Onicus undulatus Gray.)*

In northern part of State on plains and prairies.

Flowers from June until September.

Lake (Hill).

C. ODORATUS (Muhl.) Porter. Pasture Thistle.*(Onicus pumilus Torrey.)*

Occurring sparingly in fields in a few counties.

Flowers in August and September.

Dearborn (Collins); Lake (Hill); Marion (Wilson).

C. SPINOSISSIMUS Walt. Yellow Thistle.*(Onicus horridulus Pursh.)*

Reported from a single station by Dr. MacDougal and specimens in DePauw herbarium. Evidently a migrant. No additional record since original collection.

Putnam (MacDougal).

C. MUTICUS (Michx.) Pers. Swamp Thistle.*(Onicus muticus Pursh.)*

In swamps and wet soils in many counties of the State. Much more abundant in northern than in southern counties.

Flowers in August and September.

Tippecanoe (Cunningham); Kosciusko (Coulter); Noble (Van Gorder); Jay, Delaware, Randolph, and Wayne (Phinney); Vigo (Blatchley); Lagrange (Barnes); Cedar Lake (Deam); Knox (Spillman); Hamilton and Marion (Wilson); Steuben (Bradner).

C. ARVENSIS (L.) Robs. Canada Thistle.*(Onicus arvensis Hoff.)*

Found in fields and waste places in many parts of the State. It is usually found in dry soil and not only maintains itself but spreads rapidly. More abundant north. Easily recognized by its small, compact head.

Flowers from June through September.

Cass (Hessler); Putnam (MacDougal); Jay, Delaware, Randolph, and Wayne (Phinney); Noble (Van Gorder); Clark (Baird and Taylor); Kosciusko (Coulter); Jefferson; Lake, Wabash and Marion (Blatchley); Carroll; Hamilton (Wilson); Steuben (Bradner).

ONOPORDON L.

O. ACANTHIUM L. Scotch Thistle.

Established in a few localities along railroads but not spreading. Herbarium specimens from but few counties. Thus far confined to central and southern parts of the State.

Flowers in August and September.

Clark (Baird and Taylor); Jefferson (J. M. Coulter); Marion (Hessler).

CENTAUREA L.

C. CYANUS L. Corn Flower.

Found escaped from gardens and established in a few counties in the southern part of the State.

Flowers in July and September.

Clark (Baird and Taylor); Gibson and Posey (Schneck); Monroe; Steuben (Bradner); Fayette (Hessler).

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ERRATA. Dragonflies of Indiana.

- 231, l. 18, for *Dean* read *Deam*.
 244, l. 11 from bottom, for *interval between which* read *interval between, which*.
 249, l. 4, for *supplementasy* read *supplementary*.
 250, l. 13, for *front wing free* read *front wings free*.
 253, l. 2, for 1837 read 1839; l. 13, for *Massachusett* read *Massachusetts*.
 256, l. 20, for (*curinus Gr.*, read (*curinos Gr.*,
 257, l. 5, for *primrose* read *pruinose*; l. 17, for 27, *h. w.* read 27; *h. w.*; l. 1 from bottom, for *sagments* read *segments*.
 258, l. 9, for *et al* read *et al.*; l. 11, for *afsten* read *often*; l. 21, for *primrose* read *pruinose*; l. 2 from bottom, for *male* read *males*.
 259, l. 1, for *noticebly* read *noticeably*; l. 10, for VIII read VII; l. 16, for *posteriorly* read *posteriorly*; l. 6 from bottom, for *distinguish* read *distinguishes*.
 260, ls. 6 and 26, for *primrose* read *pruinose*.
 261, l. 1, for *agrionines* read *Agriionines*; l. 14 from bottom, for *primrose* read *pruinose*; l. 7 from bottom, for *sutures black* read *sutures, black*.
 262, l. 18, for *ovipositing* read *depositing*; l. 5 from bottom, for *sutures black* read *sutures, black*.
 264, l. 13 from bottom, for *Dean* read *Deam*.
 270, l. 14 from bottom, omit , after *Illinois* and add , after (*Adams*), next line.
 273, l. 11, for 2, *very* read 2, *all excepting very*; l. 16 from bottom, for *Frans* read *Frants*.
 274, l. 17, for *above the* read *above on the*; l. 19, add , after 9; line 25, add , after 10.
 276, l. 21 from bottom, for 36 read 86.
 278, l. 2, omit 7; l. 11 from bottom, for *vertel* read *vertex*.
 280, l. 8, for *has* read *have*; l. 14, for *makes* read *marks*.
 284, l. 2, change . to , after *Selys*; l. 16, for *or* read *of*; l. 25, omit . after *Selys*.
 285, l. 1, omit . after *Selys*; l. 8 and 11, for VII read VI; l. 6 from bottom, for *meso-thorax* read *mesothorax*.
 289, l. 6, add , after *May 5*.
 292, after l. 17, add G. LIVIDUS *Selys, Mon. Gomph., p. 150, 1858 (male only)*.
 295, l. 12, add . after 39.
 297, between l. 12 and l. 13, add *Ab. male 45, female 47; h. w. male 36, female 38*.
 301, l. 12, add . after *Syn*; l. 4 from bottom, add . after *p*.
 302, l. 6 from bottom, for 185 read 285.
 305, l. 13 from bottom, add . after *h*.
 308, l. 5 from bottom, for *Osborn* read *Osburn*.
 319, l. 19, for *deep* read *dark*.
 321, l. 2, for *Diplax* read *Diplax*; l. 14 from bottom, for *sympiedgo* read *sympiedzo*.
 322, l. 11, for *Rubicundulum* read *rubicundulum*.
 323, l. 13, for *rubicundula* read *rubicundulum*.
 325, l. 19 from bottom, for *becomes* read *become*.
 328, l. 15, add *Gr.*, after *diplax*.
 329, l. 7 from bottom, for *aureus L.*, read *aureus L.*,
 330, l. 5, for *L. incesta* read *L. incesta*; l. 7 from bottom, add . after 1775.
 333, l. 7 and 8, enclose *pulchella* in ().

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