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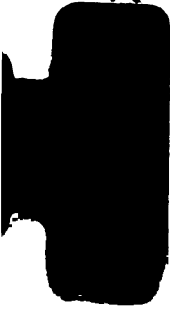


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*J. E. Hilgerson*

*Hilgerson*

INDIANA.

DEPARTMENT

OF

# Geology and Natural History

(TWELFTH ANNUAL REPORT.)

*In re.*

JOHN COLLETT,  
STATE GEOLOGIST.



TO THE GOVERNOR.

INDIANAPOLIS:  
WM. B. BURFORD, STATE PRINTER.  
1888.

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STATE OF INDIANA,  
OFFICE OF STATE GEOLOGIST, INDIANAPOLIS, January 20, 1883. }

HON. ALBERT G. PORTER, *Governor of Indiana* :

Herewith, I have the honor to submit to Your Excellency the Twelfth Annual Report of the State Geologist, being for the year 1882, as provided by law, containing the labors of myself and assistants in the field, study and cabinet, with detailed surveys of several of the most important counties of the State, and with Paleontological and Archæological, etc., studies, illustrated by figures and descriptions by some of the leading Scientists of America. With high esteem,

I remain your obedient servant,

JOHN COLLETT,  
State Geologist.

STATE OF INDIANA,  
EXECUTIVE DEPARTMENT. }

Filed with the Governor, January 26, 1883. Examined and transmitted to the Secretary of State, to be preserved in his office and published, according to law, under the direction of the Commissioners of Public Printing.

FRANK H. BLACKLEDGE,  
Private Secretary.

Filed in my office January 26, 1883.

W. R. MYERS,  
Secretary of State.





## ORGANIZATION AND WORK.

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In presenting this, his Second (and the Twelfth General) Annual Report, the State Geologist takes pleasure in calling the attention of the citizens not only of our own State, but of the whole civilized world, to the vast and varied resources of the great Commonwealth of Indiana—resources, many of which have been, until quite recently, unsuspected by those even at whose very feet they lay, and the presence and usefulness of which have in so many instances been made known first by the work of this Department.

The State Geologist is pleased to announce that the efforts of his assistants and himself have done much to bring about greater knowledge of, and added demand for, the coals of our State. The same may be said of the development of the stone interests of the State, for it is largely and directly due to the work of this Department that the Indiana building stones have become within the past few years as widely and as favorably known as they are; known not only locally, but sought after eagerly from all parts of the Union for building purposes; and to-day the visitor to Louisville and Cincinnati, Washington and Buffalo, New York and Chicago, St. Louis and New Orleans, and in other prominent cities, may see this beautiful Indiana stone in the finest and most costly public and private buildings. The advantages accruing to the State in securing new fields of industry and large returns of money from abroad to be re-invested in our midst are self-evident.

The excellent quality of our Indiana Cements is becoming better appreciated, and the market is widening, and the demand extending. The Department will take active steps in spreading a wider knowledge of the merits of these cements, which are in reality second to none in the country.



In successful civilization there is, perhaps, no greater factor in rapid development than good and easy means of communication. The ancient Romans, in their palmyest days, thoroughly appreciated this fact, and as their invincible arms swept over the whole known world, they bound their conquests together by great civilizing bands—excellent roads—which spread like a gigantic network of arteries from the great heart of civilization, Rome itself, vitalizing and building up, and keeping dependent upon that great center, the whole enormous body politic—roads so excellent that to-day, centuries after that power has declined, they stand as the best and most lasting proofs of her marvelous energy and foresight. The head and assistants of this Department have been enabled to point out, in many instances, large undeveloped and entirely unsuspected beds of fine gravel, and fortunately, too, in places where it was most needed, and which are now being used, and are bringing in a noble return for the labor bestowed upon them, in the improvement of existing and the building of new roads—thus rendering markets more accessible, farm property more valuable, and consequently produce and labor more profitable.

The amount of work done in the State Museum has been arduous and highly satisfactory. Under the able management of Mr. George K. Greene, office assistant, the difficult task of cleaning, arranging, identifying, classifying and labeling the thousands of additional specimens procured by donations, field work and purchase, has been accurately, tastefully and faithfully performed.

Additional room having become imperatively necessary, more cases have been placed in the Museum, and the archæology, paleontology and mineral resources of the State are grandly illustrated. In the Silurian, Devonian and Sub-Carboniferous formations, the Museum is particularly rich, and the State can point with pride to one of the best collections in the world of the organic remains of these ages.

The value of this public collection to the student and scientist can not be estimated, and the silent work it is doing in educating the people is evidenced in the interest and enthusiasm displayed by the thousands of visitors from all parts of the State and Nation, and the constant inquiries and communications which the Department is receiving relative to this part of

its work. The display of coals, clays, building stones and other economic products of the State are constantly bringing them into more prominent notice, thus securing large pecuniary returns to the Commonwealth.

The total number of specimens in the State Museum at the time of last year's report was 44,424. Additions made during the year give at present a grand maximum of over 100,000 specimens, valued by distinguished experts—Professor Hall, State Geologist of New York, and others—at more than *One Hundred Thousand Dollars*.

Detailed surveys, by counties, have been made as follows:

Marion county—By R. T. Brown, M. D.,  
Jay county—By Rev. D. S. McCaslin,  
Randolph county—A. J. Phinney, M. D.,  
Decatur county—By Moses N. Elrod, M. D.,

Whose reports, prepared with their characteristic faithfulness and labor, are herewith appended:

Paleontological work and descriptions are continued in this Report by the great captains and leaders of scientific thought of the age.

James Hall, the distinguished Paleontologist and State Geologist of New York, has, with his grand devotion to science, reviewed the balance of the figures of the Van Cleve fossils and contributed other figures and descriptions appertaining to the geology of Indiana.

Prof. Leo Lesquereux, the class-mate and pupil of the foremost men of science of the age, has, at great personal sacrifice, given his views upon Paleozoic Botany, with figures and drawings referring to and illustrating nearly all the fossil botany of the Indiana coal measures. This contribution covers the elementary principles of Paleozoic Botany, which can only be found in detached portions elsewhere. This valuable work of Prof. Lesquereux's will prove not only a grand contribution to the science and flora of the Paleozoic ages in Indiana, but a noble addition to the scientific literature and knowledge of the whole world.

The Rev. Dr. Curtis has given the results of years of careful research in the microscopic study of the animalculæ which have their habitat in the potable waters of Indianapolis and vicinity.

By these figures every one can see the forms of the animals which it delights his soul to swallow. These drawings have been submitted for criticism to the best experts in diatomacean forms, and are pronounced by them to be good, while the accompanying descriptions and nomenclature are fully up with advanced knowledge in natural history.

The State Geologist himself has had general supervision of the entire work of the Department. He has been in constant communication with all of his assistants; has made reconnoissances to the counties in the southwestern, northwestern, and some of the eastern parts of the State, and has more carefully made detailed examinations of Newton and parts of Jasper counties.

His time has been more largely occupied in interviews, daily, hourly, continuously, with from ten to twenty persons daily, so that his office time has been almost entirely so occupied. In addition, his correspondence has amounted to 1,200 or 1,500 letters written during the year, some of which required the greatest care and study, involving as they did information upon which depended the expenditure of large sums of money. Besides this, the usual routine of office work had to be attended to, and this was necessarily performed outside of office hours, and at night, by him.

It has been suggested by previous State Geologists that more important than any detailed surveys, of greater value than ordinary paleontological examinations to the people generally, was the grand fact that the State of Indiana kept freely open at its Capitol an office where, without money and without price, its citizens, non-residents and foreigners could always have access to reliable information relating to the natural, mineral and other resources of the State. This fact, it is believed, has in the past done much to further the interests of the State in the development of its great natural advantages, and like results may be looked for in the future.

By careful foresight on the part of the State Geologist the last Report was produced at a very low cost—less than \$1 a copy. In other States such reports have cost from \$2 to \$15, averaging \$4.80 a copy. The Department is proud of this Report; and the high favor and unqualified commendation it has received from scientists, not only at home and in our sister

States, but also in Canada, England, Germany, Australia and other foreign countries, are sufficient evidences of its value. The demand for it has been sufficient to require a far larger number than the law limited the issue to. These reports, as well as those issued previously by this Department, embodying the careful and efficient work of my talented predecessors, are in great demand among scientists all over the world, and are already regarded as valuable geological works, and have now become rare and desirable.

They are not alone contributions to the science of the age, but enable the students and teachers of the State to gain access to valuable scientific knowledge at a nominal cost, while the library of a scientist will often cost from \$10,000 to \$20,000. It is believed that the State should continue this course until not only her geology is accessible to her sons and daughters, but adhering to her duty to humanity and the advancement of knowledge and civilization, such reports shall also embody the botany, conchology and each branch of the vertebrate life of the State.

A comparison of the cost of surveys in Indiana with those of other States will show that the work has been performed here at a minimum. The Ohio Geological and Paleontological reports cost \$3.47 a copy. The Indiana Report of 1881, the most expensive yet produced, cost eighty cents per copy, while Illinois Paleontology cost about \$3.00 per copy. Indiana, at the last session of the Legislature, appropriated \$5,000 annually for geological surveys. Georgia appropriates \$10,000 annually; New York \$25,000, and Pennsylvania, \$50,000.

It may be well to remark, that Dr. C. A. White, the U. S. Paleontologist, connected with the Smithsonian Institute, is now preparing figures and descriptions of the Coal Measure fossil animals of the State, Prof. E. D. Cope, of Philadelphia, the distinguished Comparative Anatomist, is preparing figures and exhaustive descriptions of the Pleistocene fossils of Indiana, including the mastodon, elephant, megalonyx, the great beaver, the great deer, and other giant animals.

Prof. Newberry, of Columbia College, New York, who has attained such eminence in his studies of Dynamical Geology, has promised to furnish a review, illuminated by his wide ex-

perience, of the great forces which have molded the surface of the valley of the continent and done so much in enriching the soils of Indiana.

How much of these can be added to this Report can not now be fully indicated.

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NOTE.—It was found on completing this Report, that the papers by Professors Lesquereux, Cope, Newberry and Dr. White, would make the volume too large—beyond the appropriation for printing. Hence, these papers are reserved for future use, and will appear in next Annual Report.

## FINANCIAL STATEMENT

OF

## RECEIPTS AND EXPENDITURES.

By an Act of the Legislature of the State of Indiana, approved April 14, 1881, the Department of Geology and Natural History was established, and the sum of five thousand dollars annually was appropriated for two years. Pursuant to this Act the Department was organized April 26, 1881, by the appointment and qualification of John Collett as State Geologist.

The following statements, which were submitted to, and vouchers filed with, the Governor on the dates specified, show the receipts and expenditures of the Department to the close of the fiscal year, October 31, 1882:

### DEPARTMENT OF GEOLOGY AND NATURAL HISTORY, } October 31, 1881.

1881.	Salary of State Geologist, (April 28 to October 31, 1881 . . .	\$920 00
May 31.	Voucher No. 1—Postage and Express . . . . .	25 00
May 31.	Voucher No. 2—J. Fitzpatrick . . . . .	4 00
June 18.	Voucher No. 3—B. W. Osborn . . . . .	3 00
June 22.	Voucher No. 4—M. N. Elrod . . . . .	10 00
July 1.	Voucher No. 5—Carlton & Hollenbeck . . . . .	13 50
July 2.	Voucher Nos. 6, 7 and 8—Dr. C. A. White, writings and drawings for report, 1881 . . . . .	319 00
July 10.	Voucher No. 9—Ansil Moffatt . . . . .	9 40
July 28.	Voucher No. 10—Prof. Jas. Hall, descriptions. . . . .	75 00
Aug. 4.	Voucher No. 11—A. J. Phinney, field work . . . . .	30 00
Sept. 8.	Voucher No. 12—Adams Express, plates . . . . .	4 25
Sept. 20.	Voucher No. 13—M. N. Elrod, field work . . . . .	100 00
Total . . . . .		\$1,513 15

Amount of appropriation, April, 1881 . . . . .	\$5,000 00
Balance for future expenses . . . . .	\$3,486 85

Respectfully submitted,

JOHN COLLETT,

*State Geologist.*

STATE OF INDIANA,  
DEPARTMENT OF GEOLOGY AND NATURAL HISTORY, }  
INDIANPOLIS, IND., October 31, 1882.

To His Excellency, ALBERT G. PORTER,

*Governor of Indiana:*

SIR—In pursuance of a requirement of the Act of the General Assembly of Indiana, establishing the Department of Geology and Natural History, I have the honor to submit the following “detailed statement, accompanied with the proper vouchers” (Nos. 14 to 74, inclusive,) of and for all moneys expended during the fiscal year ending October 31, 1882:

1881.		
Oct. 28.	Voucher No. 14—J. T. Duty, for one lot fossils . .	\$27 00
Oct. 28.	Voucher No. 15—R. T. Brown, for field work, geological survey of Fountain county . . . . .	125 00
Oct. 28.	Voucher No. 16—G. K. Greene, for expenses to Shelby county, and geological specimens . . . . .	5 17
Nov. 9.	Voucher No. 17—E. Emmons, for drawings of fossils for Geological Report . . . . .	46 00
Nov. 11.	Voucher No. 18—L. Howard, for cleaning 54 yards carpet for office. . . . .	6 50
Nov. 28.	Voucher No. 19—R. T. Brown, for writing Geological Report, etc., in Fountain county . . . . .	125 00
Nov. 30.	Salary of State Geologist . . . . .	150 00
		\$484 67
Oct. 15.	Voucher No. 20—Geo. K. Greene, for Shelby county, expenses at Waldron . . . . .	11 70
Nov. 29.	Voucher No. 21—Neab & Keyser, for repairing sink and gaspipe . . . . .	3 75
Dec. 7.	Voucher No. 22—J. A. Weakley, for repairing and blacking two stoves and one sheet zink . . . . .	7 50
Dec. 8.	Voucher No. 23—Prof. James Hall, for electrotype cuts. . . . .	2 80

1881.			
Dec. 10.	Voucher No. 24—Daniel A. Bassett, one lot of crinoids . . . . .	\$90 00	
Dec. 31.	Salary of State Geologist for December . . . . .	150 00	
			<u>\$265 75</u>
1882.			
Jan. 6.	Voucher No. 25—Fred. Stein, for set of fresh water and land shells and classified beetles . . . . .	100 00	
Jan. 31	Salary State Geologist for January . . . . .	150 00	
			<u>250 00</u>
Feb. 13.	Voucher No. 26—Geo. K. Greene, for expenses to Hartsville and return . . . . .	11 15	
	Niagara fossils . . . . .	6 00	
	per diem, three days . . . . .	7 50	
Feb. 24.	Voucher No. 27—G. M. Levett, for arranging the Stein collection of beetles . . . . .	20 00	
Mch. 10.	Voucher No. 28—Geo. K. Greene, for work in State Museum, arranging specimens . . . . .	75 00	
Mch. 10.	Salary State Geologist for February . . . . .	150 00	
			<u>269 65</u>
Mch. 14.	Voucher No. 29—Maude Teal fossils. . . . .	3 00	
Mch. 20.	Voucher No. 30—Wm. B. Burford, for envelopes, letter heads, etc . . . . .	30 20	
Apr. 4.	Voucher No. 31—Geo. K. Greene, for cabinet full specimens and fossils, etc . . . . .	200 00	
Apr. 5.	Voucher No. 32—John Collett, expenses, surveying Shelby county . . . . .	70 75	
Apr. 6.	Voucher No. 33—John Collett, office expenses . . . . .	53 97	
Apr. 6.	Voucher No. 34—Geo. K. Greene, for work in Museum . . . . .	45 00	
Apr. 7.	Salary of State Geologist for March . . . . .	150 00	
			<u>552 92</u>
Apr. 11.	Voucher No. 35—L. Lesquereux for repairing plates of descriptions, and drawings . . . . .	50 00	
Apr. 22.	Voucher No. 36—A. N. Taylor, for 3 gross paper boxes . . . . .	3 00	
Apr. 26.	Voucher No. 37—Neab & Keyser, for mending gas pipe . . . . .	75	
Apr. 29.	Voucher No. 38—George K. Greene, for work in Museum . . . . .	37 50	
May 1.	Salary of State Geologist for April . . . . .	150 00	
			<u>241 25</u>
May 7.	Voucher No. 40—B. W. Osborn, for clerical . . . . .	15 00	
May 5.	Voucher No. 41—C. Gehring, for office fixtures . . . . .	5 00	
June 1.	Voucher No. 42—J. M. & I. B. R. Co., for freight, etc. . . . .	5 38	
June 1.	Voucher No. 43—George K. Greene, for work in Museum and expenses to New Albany and return, and for crinoids . . . . .	43 00	
June 1.	Salary of State Geologist for May . . . . .	150 00	
			<u>218 88</u>



1882.		
June 1.	Voucher No. 44—James Hall, for description and figures of St. Louis fossils . . . . .	\$100 00
June 28.	Voucher No. 45—John Collett, for office expenses . . . . .	22 25
July 1.	Voucher No. 46—George K. Greene, for work in Museum . . . . .	62 50
July 1.	Salary of State Geologist for June . . . . .	150 00
		\$334 75
July 1.	Voucher No. 47—R. E. Robinson, for expenses of Prof. Hall, Occidental Hotel, and R. R. fare . . . . .	25 00
July 14.	Voucher No. 48—Chas. S. Hensley, for Stone Age relics . . . . .	6 00
July 14.	Voucher No. 49—A. N. Taylor, for boxes . . . . .	5 00
July 19.	Voucher No. 50—W. B. Burford, for electrotype . . . . .	26 95
Aug. 1.	Voucher No. 51—John Collett, for traveling expenses, express and postage to date . . . . .	54 95
Aug. 1.	Voucher No. 52—George K. Greene, for work, traveling expenses and specimens for Museum . . . . .	70 85
Aug. 1.	Voucher No. 53—C. Gehring, for extra work . . . . .	5 00
Aug. 1.	Salary of State Geologist for July . . . . .	150 00
		343 75
Aug. 1.	Voucher No. 54—Jas. A. Wildman, for postage stamps . . . . .	20 00
Aug. 9.	Voucher No. 55—Ed. L. Rich, for embalm sturgeon . . . . .	75
Aug. 14.	Voucher No. 56—Wm. B. Burford, for printing, etc. . . . .	13 38
Sept. 9.	Voucher No. 57—D. S. McCaslin; for field work, survey and report on Jay county . . . . .	50 00
Sept. 9.	Voucher No. 58—George K. Greene, for work in Museum, expenses to Logansport, and books . . . . .	99 90
Sept. 11.	Voucher No. 59—A. J. Phinney, for services and report on Randolph county . . . . .	100 00
Sept. 16.	Voucher No. 60—John Collett, for traveling expenses to Iroquoise, Kankakee and Montreal meeting . . . . .	134 10
Sept. 16.	Voucher No. 61—Hollenbeck and American Express Co., for rubber stencil and expressage . . . . .	3 80
	Salary of State Geologist for August . . . . .	150 00
		571 93
Sept. 9.	Voucher No. 62—Ed. D. Cope, for work on Pleistocene fossils . . . . .	50 00
Sept. 5.	Voucher No. 63—Henry A. Ward, for cast of fossils, etc . . . . .	50 00
Sept. 19.	Voucher No. 64—R. L. Polk & Co., for "Indiana Gazetteer" . . . . .	5 00
Sept. 20.	Voucher No. 65—Chas. E. Beecher, for work, fossil list, etc. . . . .	50 00
Sept. 30.	Voucher No. 66—John Collett, for expenses to Newton and Jasper counties, and express packages and relics . . . . .	38 55
Oct. 3.	Voucher No. 67—G. K. Greene, for work in Museum, express charges, etc . . . . .	61 50
	Salary of State Geologist for September . . . . .	150 00
		405 05

1882.		
Oct. 3.	Voucher No. 68—Samuel Morrison, for map containing Indian names, boundary, etc. . . . .	\$12 00
Oct. 7.	Voucher No. 69—James A. Wildman, for postage stamps . . . . .	10 00
Oct. 10.	Voucher No. 70—Adams Express Co., for express package . . . . .	2 75
Oct. 21.	Voucher No. 71—L. Lesquereux, for drawing plates, etc . . . . .	197 00
Oct. 22.	Voucher No. 72—Samuel Morrison, for making outline survey maps of Indiana, and correcting Marion county map . . . . .	21 00
Oct. 31.	Voucher No. 73—John Collett, for expenses to Cincinnati with Greene's specimens crinoids; expenses to Newton, White, Cass, and Carroll counties . . . . .	83 40
Oct. 31.	Voucher No. 74—Geo. K. Greene, for work in Museum and expenses Cass, Carroll and White counties . . . . .	96 05
Oct. 31.	Salary of State Geologist for October . . . . .	150 00
		572 20
	Total for current year . . . . .	\$4,510 30
	Amount on hand October 31, 1881 . . . . .	\$3,486 85
	Appropriation April 14, 1881 . . . . .	5,000 00
		8,486 85
	Total . . . . .	<u>8,486 85</u>
	Amount on hand unexpended to cancel bills and expenses already incurred, and for future expenses . . . . .	\$3,976 55

Respectfully submitted,

JOHN COLLETT,

*State Geologist.*

RECAPITULATION.

Appropriation, April 1881 . . . . .	\$5,000 00
Appropriation, April 1882 . . . . .	5,000 00
	\$10,000 00
Expenditure for fiscal year ending October 31, 1881 . . . . .	\$1,513 15
Expenditure for fiscal year ending October 31, 1882 . . . . .	4,510 30
	6,023 45
Amount unexpended October 31, 1882 . . . . .	\$3,976 55
Amount expended since October 31, 1882 . . . . .	2,597 52
	\$1,379 03
Balance on hand February, 1883 . . . . .	\$1,379 03

Contracts for labor and other expenses will completely exhaust the balance of this appropriation by the end of the departmental year, during the coming April, 1883. Hence, if this Department is continued, as it ought to be, permanently, as a fountain of information to citizens and business men, and others wishing to locate in the State, it is indispensable that appropriations be made for the ensuing two years, *i. e.*:

From April 14, 1883, to April 14, 1884.....	\$5,000
From April 14, 1884, to April 14, 1885.....	5,000

Proposals have been made to the State Geologist offering to sell three collections of prehistoric relics (which in money, labor and time expended, represent a value of more than \$11,000,) to the State Museum for a nominal sum, and some collections of fossils which embrace over fifty years' labor and several thousand dollars in money, provided they can be sold to the State Museum, where they can be permanently preserved.

If these offers are not embraced, and these collections are scattered abroad, it would be impossible to replace them at less than four times the proposed price.

For this purpose it is advisable, proper and desirable that appropriations of \$2,000 per annum, for two years, should be made, *i. e.*:

For the year 1883 .....	\$2,000
For the year 1884 .....	2,000

*It is important that legislators should understand distinctly that by the Act of 1881, establishing this Department, every cent of appropriation unexpended must be turned into the State Treasury; so that after April 14, 1883, there will not be a single dollar left on hand to prosecute the work of the Department, to care for and preserve the Museum, (worth, as stated before, over \$100,000) or to guard the Economic Geological interests of the State.*

## GENERAL ECONOMIC GEOLOGY.

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Indiana has been bounteously endowed by nature. In other regions rich in ore, coal and stone, the soil is usually thin and unproductive, or *vice versa* fertile lands are not rich in mineral treasure; but here in Indiana, a bountiful and inexhaustible supply of mineral wealth is overlaid by the richest of soils; and with cheap and abundant food, cheap homes, cheap wood and coal for fuel, and good clays, sands, and the finest of building material, she offers to the farmers, laborers, mechanics and manufacturers a share of her abundant blessings, resources richer and more useful to humanity than gold or silver or precious stones.

### BUILDING STONE.

The rocks of the State contribute largely to her wealth, for they contain some of the finest building stone in the country, and the supply, comparatively undeveloped yet, is practically inexhaustible. The excellent qualities, durability and beauty of these Indiana stones are just beginning to be recognized for building purposes throughout the country, and the quarrying interests promise to become an important feature in the products of the State, in the near future. This stone is being extensively used in some of the most expensive and imposing buildings throughout the country, and the demand is increasing as it becomes better known. During the year 1880, the capital invested in the operation of quarries was \$613,500, and the output of material was 8,413,827 cubic feet, worth \$633,775, or about \$20,000 more than the total capital employed. To effect this result required the labor of 1,788 men and 545 horses, and the use of 13 steam channellers in quarrying; 107 derricks and

cranes in hoisting; 14 saw mills and 42 gangs of saws (3 per mill), in dressing; while 5,727,225 cubic yards of space were excavated, in doing which \$2,300 worth of powder and dynamite was used.

As to the geographical division of the quarrying interest, south-eastern Indiana supplies a large quantity of stone for foundations and rubble masonry, from the bluffs along the Ohio river, and extending through Wayne, Union, Fayette, Franklin, Dearborn, Ohio and Switzerland, west to Clark county; besides being found to some extent in the counties adjoining these to the west, which are included in the Lower Silurian geological range.

The close-grained, compact, magnesian limestones are largely quarried in the counties bordering the above on the west, forming a belt extending northward from the Ohio to the Wabash river in Carroll, Cass, Miami, Wabash and Huntington, and to some extent in the counties north and west of these. This stone, which belongs to the Upper Silurian age, lies in even beds, having a thickness of from a few inches to two or more feet, and is especially adapted to work in foundations, piers, abutments, and massive range work where great strength is required. The thinner strata of this stone furnish, at a low cost, excellent slabs, flags and curbstones, etc., since it comes from the quarries with bed and top ready dressed by nature. The economy in its use is apparent.

A very popular stone among engineers and bridge builders is the North Vernon blue limestone, a good sample of which, as a bridge building material, may be seen in the new bridge of the C. & I. Air Line across Broad Ripple, north of Indianapolis. This stone is quarried extensively in Jennings and Jefferson counties.

Quantities of blue and buff Oolitic stone of superior quality for building purposes are quarried in Monroe county. These strata are from six to twenty feet thick, from whence one firm alone, Messrs. Dunn & Dunn, has been shipping their entire output to Chicago and Joliet, Ill. It is there sawed into thin slabs, matched and polished, and finds a large and growing demand for mantels, table-tops, pilasters, wainscots, and interior ornaments and decorations where handsome neutral tints are required.

From Warren county on the north to the Ohio river, in a widening range, the valuable limestones of the Keokuk group, the sandstones of the Chester, and Oolitic limestones of the intermediate St. Louis group, are quarried; while the basal conglomerate sandrock, found in a wide belt from Warren county to the Ohio, contains an unlimited supply of strong, fire, water, and frost proof stone, very suitable for piers, foundations, etc.

But by far the most beautiful and valuable stone for architectural purposes is the Oolitic limestone of Lawrence, Monroe, Owen, Crawford, Harrison and Washington counties. The supply is simply inexhaustible, as it lies in massive strata of from twenty to seventy feet thick, over an area of more than fifty square miles.

These strata are homogeneous, equally strong in vertical, diagonal or horizontal sections. The stone comes from the quarry so soft as to be readily worked by saw, chisel or planing machine, while on exposure it hardens to a strength of from 10,000 to 12,000 pounds to the square inch—a strength amply sufficient to sustain the weight of the largest structure in the world. In use it presents a handsome, creamy brown appearance, gradually whitening with age. It is of almost unprecedented purity, containing an average of 96.8 per cent. of carbonate of lime, a purity rarely, if ever, surpassed, and scarcely equaled, in the world. Hence its advantage over the magnesian limestones, as it is not affected by decay in an atmosphere charged with the gases of burning stone coal. In natural outcrop it presents bold perpendicular faces to the elements, showing every scratch and mark, unaffected after the exposure of thousands of years, as no other stone or rock does.

It is quarried by steam channelers, which carve it out in prisms six by ten, fifty or one hundred feet long, putting to shame the boasted prodigies of Egyptian story and effort. It is then rapidly sawed into blocks and dimension forms, and steam planers carve, mold and smooth it like clay or wood, and more accurately than mallet and chisel. It is now fit to be carved and polished into the freest kind of sculptured and ornamental work.

Ready for the mason or sculptor, it is alive and resonant, answering with a clear metallic ring each touch or blow. This resonance is an excellent test of the perfect unity of its parti-

cles, and as a result it is highly elastic, bending under pressure and rebounding to place when relieved from it. This elasticity enables Indiana Oolitic limestone to adapt itself without cleavage or disintegration to our changeable climate, where material will be frequently subject to a change of from 20° to 60° of temperature in a few hours; as in large buildings, the outside will be subject to a temperature of 25° below zero in winter, or 120° above it in summer, while the inside will remain at 60° or 70°—differences of 50 to 80° in the extremities of the same stone—with their accompanying effects in expansion or contraction. The strains of heat and frost will tear down buildings and sides of mountains, with their great expansive forces, and even steel and iron will give way before them. Here, then, is presented to the builder and architect a new and wondrous element in an “elastic stone,” a potent quality which, united with its other sterling excellencies of strength and beauty, makes Indiana Oolitic limestone the *best in the world* for exposed work in buildings in localities subject to great climatic changes. It has been and is now being used in many of the finest public structures in the country—the new \$2,000,000 court house at Indianapolis, the new Indiana State House, the postoffice, and many churches in that city; the custom house at Louisville; the city hall and the water-tables of Lincoln park in Chicago, many fine structures in St. Louis, the Cotton Exchange in New Orleans, and many public and private buildings in New York and Philadelphia, and the exposed parts of the new State House of Illinois.

*The sandstones* of Indiana occur in a broad belt from the Illinois line, in Warren county, south and southeast through the counties of Fountain, Vermillion, Montgomery, Parke, Putnam, Clay, Owen, Greene, Martin, Pike, Dubois, Orange, Perry, Crawford and Harrison, to the Ohio river. This is the conglomerate sand-rock, forming the base of the coal measures, and the same as the sandstones so famous in Scotch and English architecture; and, although irregular in color and physical characteristics to some extent, presents a great bed of building material, frost, fire and water proof, and of practical value for permanence and solidity. In these beds, in Warren, Orange, Lawrence, Crawford and Harrison counties, are found extensive and valuable bands of grit stones, of great utility for grind-

stones, as well as quarries of the "Hindoostan" whetstones, so favorably known in all the markets of the civilized world.

The sandstones of the coal measures proper, while not fully up to the above, are yet extensively used for foundations, piers, and hammered masonry. In the Sub-Carboniferous formation, the sandstones of the Chester and Knobstone groups are well developed, easily accessible, and merit the local favor and reputation they sustain.

During the year 1882, there were quarried in Indiana nearly 1,000,000 cubic yards of sandstone.

#### COAL.

The Indiana coal fields are embraced in an area of about 7,000 square miles, and are entered from all directions by railroads, thus insuring a steady and inexhaustible supply of the best fuel at a low price. There are in all twelve seams at varying depths, from the surface to three hundred feet below, averaging a depth of eighty feet. Five of these seams are almost constantly workable wherever met, varying from one-half to eleven feet, and averaging four feet in thickness. The small seams are worked for local use by "stripping."

These coals range in quality from "fair" to "superior." The "block coal," pre-eminent as a metallurgic agent, is found in an area of about 600 square miles. Remarkably free from sulphur and phosphorus, it is rich in carbon, and admirably adapted to the manufacture of "Bessemer" steel, and for refining, as well as for rolling mill and locomotive use. It burns free, without caking, to a minimum of white ash, and with a ruddy flame.

Mr. J. J. Turner, Superintendent of the Indianapolis & Vincennes Railroad, made for some weeks a careful test of the comparative merits of Indiana coal (from Greene county) and the celebrated Pittsburgh coal, with especial reference to locomotive purposes, with the following results:

	<i>Pittsburgh.</i>	<i>Indiana.</i>
Wheels hauled one mile per ton coal .....	.97	.99
Gallons of water evaporated per ton coal.....	.53	.52
Average temperature during test .....	39°	39.9°
Total consumption.....	.40	.35



The enormous amount of power stored up in coal is thus set forth by Prof. Rogers: "The dynamic value of one pound of good steam coal is equivalent to the work of one man for one day, and three tons are equal to twenty years' hard work of 300 days to the year. The usual estimate of a four-foot seam is that it will yield one ton of good coal for every square yard, or about 5,000 tons per acre. Each square mile will then contain 3,200,000 tons, which, in the total capacity for the production of power, are equal to the labor of over 1,000,000 able-bodied men for twenty years."

Of course this contemplates that period in the future when inventive genius shall develop processes by which the full power of coal shall be economized, now so wasted in smoke and imperfect combustion.

During the past year the coal mines of Indiana employed 5,000 men, to whom were paid wages amounting to over \$1,500,000. In the mines was invested a capital of \$2,500,000, while the product was 1,500,000 tons of coal, worth at the mines \$2,500,000, a sum equal to the capital invested.

From a small beginning in a region where wood fuel was so abundant as to be a drawback, the excellent quality of our coal has promoted Indiana to the place of sixth in the coal-producing States of the Union, with a gain of 231 per cent. in the past decade, or over 23 per cent. per annum, while the future promises still larger outputs and triumphs.

How much influence the State Geological Department has had in producing the above results may be inferred from the fact that since 1870, when the first full report of the coals of Indiana was made by my predecessor, Mr. E. T. Cox, the business has increased about 250 per cent.

#### GLASS SAND.

Extensive beds of sand and friable sandstone occur in the counties of Madison, Parke, Clark and Harrison. It is of ocean-washed purity, frequently white as snow, and so pure as to cause the plate-glass of our State to rival, and in some respects to excel, the best European products. With fair encouragement Indiana can supply the nation with glass cheaper and better than foreign manufacturers, and can at the same time

give employment to thousands of skilled and unskilled laborers, and bring additional capital within her borders.

#### GRAVEL.

This is so bountifully present over nearly all the State that it is as common as air *and as unprized*. Other countries make costly highways with broken stone; here nature presents the best of granite, imported during the great "Ice age," ready prepared for use. This is the best possible material, and in the future, with ordinary enterprise, our State will have the best roads in the world, with the consequent blessings of comfort, enjoyment and profit. During the year the sale of gravel in the State amounted to about 200,000 cubic yards, but probably ten times that amount was used without cost.

#### LIME AND CEMENT.

These necessities of life are so abundant in the State as to escape attention. The whole northern, central drift regions and eastern and middle parts are underlaid with good limestone, suitable for calcining. The very best quality of lime is produced from these rocks, and in quantities not only sufficient for home consumption, but for an extensive trade in exportation also. To-day it is only used for mechanical purposes, but its full value will be appreciated when, in the near future, it becomes more generally used in agriculture for fertilizing purposes. The lime of the Upper Wabash, Central and Southern Indiana is unrivaled; the Delphi and Huntington and Utica limes are of very superior quality.

Cement that meets all the requirements of the market is prepared from the native beds of Clark county, and is of fine quality; while large beds still undeveloped exist in Harrison county, waiting to reward him who will turn his attention to and bestow his labor upon them. From the lacustral clays and chinks of St. Joseph county is made, at South Bend, a fine "Portland cement," which is not rivaled even by the best European brands. During the year 1882 there was produced in the State 836,628 bushels of lime and 82,938 bushels of cement.

## CLAYS AND KAOLIN.

Brick clay is as common as water throughout the State. Owing to the presence of iron, the clays of Delphi, Carroll county, offer a product of extra beauty, smooth and ruddy, and with colors so fixed that buildings which have stood for twenty or twenty-five years present the same cheerful, bright appearance as those erected last year. Our builders would do well to consider the color and quality of this material, permanently painted by nature.

The kaolin mines of Owen and Lawrence counties have lately opened a new and prosperous field of labor. The product of these mines is used by the "Encaustic Tile Works" at Indianapolis, where are being produced tiles of rare beauty and excellence, rich in design, perfect in form, equally vitrified, and unrivaled by the best factories of England and France, over whose products they take precedence in the great public buildings in eastern cities. Large beds of kaolin, still undeveloped, invite exploration and examination in Harrison county. The discovery of these kaolin beds has already resulted in the importation of large amounts of capital, and numbers of foreign skilled workmen.

Underlying all our coal seams are great beds of excellent fire clay. Good fire brick are made in Clay and Vermillion counties, and the raw material is abundant in the southwestern regions. When the coming man builds, not for to-day, but for all time, he will require permanent fire-proof edifices, and will then avoid disastrous conflagrations by cheaply furnishing from this clay, window and door frames, roofs, cornices, etc., and ornamental brackets of terra cotta ware. The supply is sufficient to furnish the world, and when common sense prevails, the clays of Indiana will be richer than the mines of Colorado and the golden sand of California. During 1882, 2,769 tons of fire clay were produced.

## GAS.

In Harrison and other counties considerable areas present from the deep bores a flow of gas distilled by the internal heat of the earth from the bituminous beds of the Devonian age.

This flow has been utilized for concentrating brine, and is of great economic value for driving engines, burning lime, crockery, etc., as well as for illuminating and culinary purposes. It invites and deserves attention.

#### SOIL.

The soil of Indiana is composed of materials from all the geological horizons. It contains the elements of all, spread as a broad alluvial plain along the ancient glacial bed. Being deep, it holds like a sponge the excess of winter and spring moisture to alleviate with dews, or water by springs, the surrounding country, avoiding excessive drouth. Posey county has shown to the State Board of Agriculture 180 bushels of corn to the acre, while Vermillion county comes to the front with 64.78 bushels of wheat and 110 bushels of oats to the acre. Other regions are equally rich, showing results in grains and grasses which rival these. Such crops are not accidents, but are the legitimate and natural results of a superior soil and its mineral constituents. When we consider that a soil composed of the decomposition of local rocks only is lean and soon needs manure, we can appreciate the effects of the deposition of the glacial drift over Indiana in the almost fabulous fertility of its soil as instanced by the above examples.

## UNITED STATES SURVEYS AND GROWTH OF TIMBER.

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When first visited by the white race, at least eight-tenths of the area now known as the State of Indiana was covered with a heavy growth of timber, a part of the great "forest primæval" of the wonderfully wooded Mississippi Valley. In course of time, as the land came into possession of the whites and was first surveyed, it was found that the easiest way of marking corners and subdivisions of land, as well as the lines of separation, was by blazing or carving well-known marks or scores upon the neighboring trees.

The State was originally subdivided into ranges as follows:

Two principal meridian lines were established, running north and south from a fixed natural point, the first on the eastern boundary, north from the mouth of the Great Miami river; the second north from a point on the Ohio river  $9^{\circ} 29'$  west from Washington. These were intersected at right angles by base lines, the principal one for Indiana running west through the counties of Clark, Washington, Orange, Dubois, Pike, Gibson and Knox. The country was then divided, by lines parallel to the Meridian and base lines, into *Townships* six miles square, which were subdivided by lines, run by deputy surveyors, into *Sections* of one mile square, or 640 acres; and these were subdivided into quarter sections of 160 acres. Such divisions were established by plain marks on trees in the forests, or by posts and mounds in the treeless districts. *Ranges* are divisions six miles wide, counting east or west from the principal meridians. *Townships* are numbered north or south from the base line.

The map herewith presented gives the exact date and author of each one of these subdivisions, and as it is not accessible in any known published work, it is here given, not only for the purpose of confirming and making fixed the corners and land-

marks of farms, thus avoiding law suits and neighborhood difficulties, but also for the scientific and economic purpose of enabling the public to know, by observation of surveyors and others, the age of trees and the growth of timber. Although it is a generally accepted fact that trees register their growth by annular markings, yet a system of inspection should be inaugurated by the ninety-two County Surveyors of the State, and other observers, which will establish the actual facts relating to the growth of different kinds of trees, and to show that each ring represents the annual growth of the trees, as is well known, or the contrary, as some suppose.

In this period, when so much earnest attention is given to forestry and the growth of timber, measurements made by the same observers will exactly determine the amount of growth of different species of trees on different kinds of soil, and faithfully tell by the records of the past and present what kinds of trees to plant, or the contrary, and on what soils profitable returns may be expected.

To the County Surveyor, to whom probably such a map has not heretofore been accessible, it is believed it will prove of great value; and in fixing the landmarks of farms it will be of priceless worth, since, by the rings of growth the original Surveyors' marks may be identified, and hence the true boundaries established; from which tests may be made even of surrounding districts outside of the counties where found, and from these again adjoining lines may be corrected.

Appended are the instructions issued by the Surveyor General, at Columbus, Ohio,\* which were in force and governed the Surveyors in that State, in Central Indiana, and it is believed controlled the original surveys also in Northern and Southern Indiana, as well as the State of Illinois.

The sample map included in the instructions to Deputy Surveyors by the Surveyor General is also added, giving an ocular exhibit of the mode in which maps were prepared; the whole giving information which it is believed is not accessible elsewhere to surveyors of Indiana and other States.

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\* These instructions are an exact copy of the original documents used, and which governed the surveys of John Collett, Stephen S. Collett and Josephus Collett, and other Surveyors of Central Indiana, as attested thereon by the certificate of Josephus Collett, in 1818 to 1823.

## GENERAL INSTRUCTIONS OF THE SURVEYOR GENERAL TO DEPUTY SURVEYORS.

You will provide a good compass of Rittenhouse's construction, having a nonius (vernier) division and moveable sights; and a two-pole chain of fifty links which must be adjusted by the standard chain in the office of the Surveyor General, and it will be of importance that both it and the compass be frequently examined in the field, in order to determine and rectify any errors and irregularities which may arise from the use of them.

Whenever your course may be obstructed by insuperable obstacles, such as ponds, swamps, rivers, creeks, precipices, etc., you will take the necessary offsets, or work by a traverse or trigonometry, in order to ascertain the distance on any line which is not actually run.

The courses of all navigable rivers which may bound or pass through your district, must be accurately surveyed and their width taken at those points where they may be intersected by the township or sectional lines, and the distance on any course of the meanders, at which you may intersect those points. There must be corners established at all those points, and their distance from the sectional or township corners noted. You will likewise notice all streams of water which fall into those rivers, with their width at the mouth, and the courses whence they appear to come, all islands with those points on the meanders which may be opposite the upper and lower parts of the islands, and all rapids, falls or cascades.

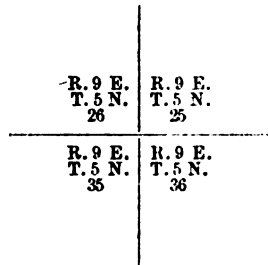
All township or sectional lines which you may survey are to be marked in the following manner, viz.: All those trees which your line cuts, must have two notches made on each side of the tree, where the line cuts; but no spot or blaze is to be made on them, and all, or most of the trees on each side of the line and near it, must be marked with two spots or blazes, diagonally or quartering toward the line.

Posts must be erected at the distance of every mile and half mile from where the township or sectional line commenced (except a tree may be so situated as to supply the place of a

post). All mile posts must have as many notches cut on them as they are miles distant from where the town or sectional line commenced; but the town corner posts or trees shall be notched with six notches on each side. The half mile posts are to be without any marks. The places of the posts are to be perpetuated in the following manner, viz.: At each post the courses shall be taken, and the distance measured to two or more adjacent trees in opposite directions, as nearly as may be, which trees, called *bearing trees*, shall be blazed on the side next the post, and one notch made with an axe in the blaze.

And in case any corner should fall in a prairie, or other place where there may be no bearing trees within a convenient distance, you will, as the mark of such corner, raise around the post a mound of earth or pile of stones not less than two and one-half feet high, and two and one-half feet diameter at the base; and there shall be cut with a marking iron on a bearing tree, or some other tree within and near each corner of a section, the number of the section, and over it the letter T with the number of the township, and above this the letter R with the number of the range; adding to the number of the township the letter N or S, as it may be *North* or *South* of the base line; and to the number of the range, the letter E or W as the range may be *East* or *West* of the meridian. But for the quarter section corner you are to put no numbers; they are to be distinguished by this mark: "¼ S."

For the manner of numbering at the section corners, see example in the margin:



You will be careful to note in your *field book* the courses and distances of all lines which you shall have run, the names and estimated diameters of all corners or bearing trees, and those trees which fall in your line, called *station or line trees*, notched as aforesaid, together with the courses and distances of the bearing trees from their respective corners, with the letters and



numbers marked on them as aforesaid; also, all rivers, creeks, springs and smaller streams of water, with their width and the course they run in crossing the lines of your survey, and whether navigable, rapid or otherwise; also, the face of the country, whether level, hilly or mountainous; the kinds of timber and undergrowth with which the land may be covered, and the quality of the soil; all swamps, ponds, stone-quarries, coal beds, peat or turf ground, uncommon, natural or artificial productions, such as remains of ancient fortifications, mounds, precipices, caves, etc.; all rapids, cascades, or falls of water, minerals, ores, fossils, etc.; the true situation of all mines, salt licks, salt springs, and mill seats, which may come to your knowledge, are particularly to be regarded and noticed in your field book.

In all measurements the level or horizontal length is to be taken, and not that which arises from measuring over the surface of the ground, when it happens to be uneven and hilly. For this purpose the chainmen, in ascending or descending hills, must alternately let down one end of the chain to the ground and rise the other to a level, as nearly as may be, from the end of which a plumb should be let fall to ascertain the spot for setting the tally-rod or stick, and where the land is very steep, it will be necessary to shorten the chain by doubling the links together so as to obtain the true horizontal measure.

Though the lines be measured by a chain of two perches, you are, notwithstanding, to keep your reckoning in chains of four perches, of one hundred links, and all your entries in the field book, and all your plans and calculations accordingly in chains and links.

As the principal source of error in surveying is in the measurement by the chain, you will be careful to attend to your chainmen, that they carry the chain horizontally, and to prevent their losing a tally-rod you must be provided with a set of them, pointed with iron or steel, and to allow none other to be used but the precise number which you shall have selected for the purpose.

You will also, frequently, while in the field, attend to the correction of your chain. For this purpose you should be provided with some measure taken from the standard chain in the office of the Surveyor General.

All lines (whether random or true) are to be noted in your field book at the time of running, and are to be kept in the order in which the work is executed; also, you must be careful to note the variation of the random lines from the corners or posts which they are intended to strike.

All courses of whatever lines must be taken with the sights of your compass set to the variation, and estimated according to the true meridian. For which purpose the variation of the needle at the place where you survey, must be taken or previously known, and your compass regulated to it before you commence running the lines.

No lines, of whatever description, are to be run, or marks of any kind, made by any person but yourself or one who may be under the immediate direction of yourself or some deputy surveyor duly authorized from this office.

In your *field book* the courses and distances must be placed in the margin, on the left, and your remarks and notes made on the right. The best form for the field book is that of a sheet of foolscap paper folded into sixteen pages.

The following is a specimen of the most approved manner of taking field notes:

NORTH.		Between Sections 35 and 36, T. 4 N., R. 9 East, first Meridian.
<i>Chs.</i>	<i>Lks.</i>	
20	30	A white oak, 20 inches diameter.
37	10	A stream, 30 links wide, course S. E.
40	00	Set half mile post, from which a B. oak, 18 inches diameter, bears S. 29, E. 17 links dist., and a W. oak, 24 inches diameter, bears N. 15, W. 23 links dist.
53	75	A spring, course East.
65	81	A sugar tree, 12 inches diameter.
80	00	Set post corner to Secs. 25, 26, 35, 36, from which a sugar tree, 15 inches diameter, bears N. 42, W. 9 links, and a poplar, 30 inches diameter, bears S. 19, W. 12 links. First half mile hilly, second rate; last half-level, first-rate. B. oak, W. oak, hickory, sugar tree, poplar, walnut, etc. Undergrowth, spice, etc.
EAST.		Between 25 and 26, on random.
<i>Chs.</i>	<i>Lks.</i>	
12	59	A stream, 25 links wide, course S.
19	50	Enter prairie.
40	00	Set temporary $\frac{1}{2}$ Sec. post in prairie.
55	00	Left a prairie.
60	75	A brook, 10 links, S. E.
74	09	A brook, 5 links, S. E.
79	86	Intersected east boundary 12 links north of post. Land level and rich. Timber—sugar, ash, poplar, oak, and so forth. Part prairie rich.

<b>WEST.</b>		Corrected West, between Sections 25 and 36.
<i>Chs.</i>	<i>Lks.</i>	
39	93	Set post at average distance on true line for $\frac{1}{4}$ Sec. corner in prairie, where raised a mound.
79	86	Section corner.
<b>NORTH.</b>		Between Sections 25 and 26, T. 4 N., R. 9 E., first Meridian.
<i>Chs.</i>	<i>Lks.</i>	
15	40	A stream 25 links wide, course S. E.
21	50	Enter prairie.
40	00	Set half mile post in prairie, no bearing trees.
67	25	To timbered land.
69	92	An ash, 24 inches diameter. Etc., etc.

In this manner you must enter all courses and distances in your field book, and the date must follow the close of each day's work, which field book, written with a fair hand, of each township separately, or a true and fair copy, together with the *original*, you will return to the office of the Surveyor General.

The plats of each township and fractional part of a township must be neatly and accurately protracted on *durable* paper, with an inch of margin on each side, by a scale of two inches to a mile or forty chains to an inch, and must be in such measure and proportion, in every line and part, as actually was determined by measurement in the field. The scale by which the lines are laid down, with the true and magnetic meridian raised on the end thereof, are to be placed on the southeast corner of the plat.

The following certificate must be inscribed on your plat and signed by you :

Pursuant to a contract with and instructions from....., Surveyor General of the United States, bearing date.....day of....., I have admeasured, laid out and surveyed the above described township (or fractional township) and do hereby certify that it had such marks and bounds, both natural and artificial as are represented on said plat, and described in the field notes made thereof, and returned with the plat into the Surveyor General's office.

Certified this.....day of.....

## INSTRUCTIONS FOR SUBDIVIDING TOWNSHIPS.

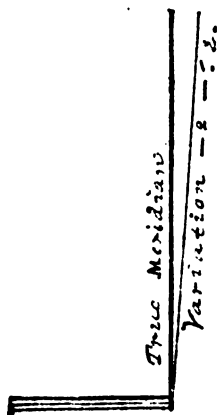
Each side of a section must be made one mile in measure by the chain, and quarter section corners are to be established at every half mile, except in closing a section. If the measure of the closing line should vary from eighty chains, or one mile, you are, in that case, to place the quarter section corner equi-distant, or at average distance from the corners of the section. But in running out the sectional lines on the north or west side of the township, you will establish your quarter section corners at the distance of forty chains from the last section corner, in order that the excess or deficiency of the township as to complete sections may fall on the north and west sides (according to the provisions of the Act of Congress of the 10th of May, 1800,) which balance or remainder you will carefully measure out to the township boundary, and put down in your field notes, in order to calculate the remaining or fractional quarter sections on the north and west sides of the township. Also in running to the northern and western boundaries, unless your sectional lines fall in with the corners established thereon for the corners of sections in adjacent townships, you must set a post and take bearing trees at the points of intersection of your lines with the town boundaries, and take the distance of your corners from the corners of the sections of the adjacent townships and note that, and the side on which it varies, in chains or links, or both.

The sections must be made to close by running random lines from one to another, (except on the north and west ranges of sections,) and the true lines between them are to be established by means of offsets from the random.

In fractional townships on rivers it will be necessary to vary from the foregoing rules, and the lines must be continued from the rectilinear boundaries of the townships which may be parallel to the river, perpendicularly to those boundaries till they intercept the river. The section must be made complete on the sides of the townships bounded by straight lines, and all excess or defect of measure must be thrown into the fractional sections on the river.

The measure of the lines from the last section corners should be made very exact.

	A	a	B	z	C	c	D	2	E	e	F	f	G
	41.00	40.00											
y <sub>19</sub>	Sec. 6	6	Sec 5	6	Sec. 4	6	Sec. 3	6	Sec 2	6	Sec. 1		g
y <sub>18</sub>	41.07	40.00											h
x	Sec 7	8	Sec 8	8	Sec 9	8	Sec 10	8	Sec 11	8	Sec 12		i
x <sub>17</sub>	41.22												j
w	Sec 18	4	Sec 17	4	Sec 16	4	Sec 15	4	Sec 14	4	Sec 13		k
w <sub>16</sub>	40.94												l
v	Sec 19	3	Sec 20	3	Sec 21	3	Sec 22	3	Sec 23	3	Sec 24		m
v <sub>15</sub>	41.10												n
u	Sec 30	2	Sec 29	2	Sec 28	2	Sec 27	2	Sec 26	2	Sec 25		o
u <sub>14</sub>	41.14												p
t	Sec 32	1	Sec 32	1	Sec 33	1	Sec 34	1	Sec 35	1	Sec 36		q
	T	S	N	R	Q	P	O						N



Begin at O, corner of sections 35 and 36, and run a true north course forty chains, and establish the quarter section corner between sections 35 and 36; continue forty chains further on the north line and establish the corner of sections 25, 26, 35 and 36. From this corner run a random line east for the corner of 25 and 36 on the east boundary without blazing, and at the distance of every twenty chains on this line, set up a stake or make some other mark on the random line. If you strike the corner at M on the range line exactly, you have

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only to blaze back and establish the quarter section corner at the average distance between the corner on the range line at M and corner of sections 25, 26, 35 and 36. But if your random line falls north or south of the corner on the range line, you must note the deviation in your field book, and return on the true course, blazing your line and observing to correct it by means of offsets from the marks made on the random line.

From the corner of section 25, 26, 35 and 36, run due north one mile (setting the quarter section post as before at forty chains), and establish the corner of section 23, 24, 25 and 26. Then run a random line as before for the corresponding corner at L, on the range line, and correct back on true line. In this manner proceed with the eastern tier of sections until you arrive at the corner of sections 1, 2, 11 and 12. From this corner run, as before, a due north course, between sections 1 and 2, forty chains, and establish the quarter section corner; continue north to the town boundary, noting the distance at which you intersect it. If you intersect the town boundary at the corner established for sections 35 and 36 of the township north of you, you have only to make the proper marks for (and within) sections 1 and 2, denoting their numbers with the number of the township and range. But if you intersect the town boundary east or west of the corner of sections 35 and 36 of the town adjacent, you must establish your corner for sections 1 and 2, at such points of intersection, making the proper marks as above, and noting carefully in your field book this distance of intersection from the corner of 35 and 36, and whether east or west of it.

Return south, and from the corner on the south boundary of sections 34 and 35 at P, run north on the second tier of sections, closing on the section corners previously established by random lines as before, and closing to the north boundary in same manner.

In this manner proceed until you arrive at the last section corner toward the western boundary, from which corners you are to run out *true* lines due west, and establish the quarter section corners at forty chains, carrying out into the last tier of quarter sections (as on the north boundary) whatever excess or deficiency there may be in the measure of the township, in the same manner as directed in closing to the north boundary,



taking care to establish corners at the intersection of the western boundary, and to note the distance you may intersect north or south of the corner established for sections in the township adjacent.

Great care must be taken that the north and south lines be run according to the true meridian, as required by law, and the east and west lines at right angles to them as far as is practicable in closing. But, if on running a due east and west line, you find the post you are running for lies very much to the north or south of the line, you are then to mistrust the measure by the chain, and, if possible, the lines on which the posts are established must be re-measured. Also in running the north and south lines, if you find by the measurement of the closing line, that there is a uniform convergency or divergency of those lines, you may then reasonably mistrust the accuracy of the direction of your lines by the needle. In such case, it will be well to endeavor to run parallel to the meridian adjacent on which the sections close, in order that they may contain a just or legal quantity, viz.: 640 acres, or one mile square.

You will take care that your posts be well driven into the ground, and that there be one or two sight trees marked between every corner.

Any considerable departure from these instructions will be considered as a forfeiture of the conditions of the contract, or any claim for payment; and loose, inaccurate or precipitate work *will not be admitted*, either as respects surveys in the field, or their returns on paper.

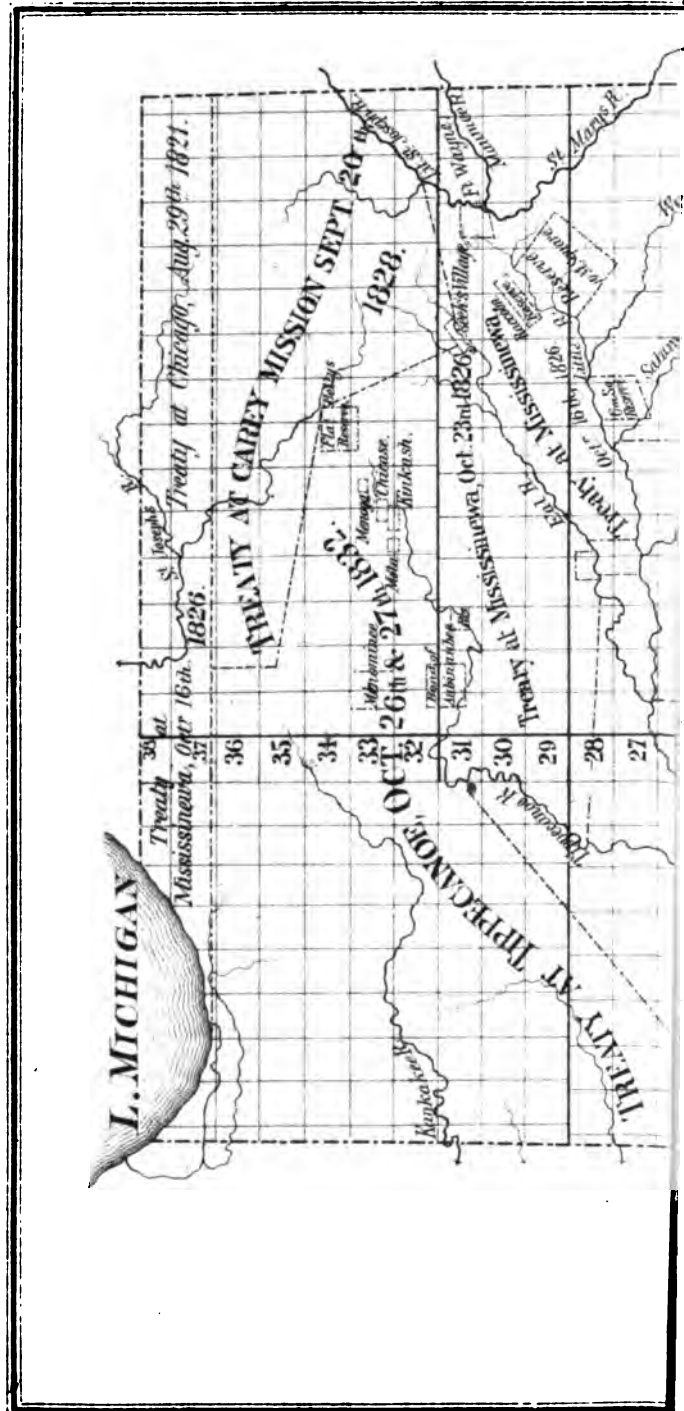


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## ARCHÆOLOGY.

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Our earliest predecessors, the Mound Builders, are gone. Obeying the immutable natural laws of selection and the survival of the fittest, driven off by a more vigorous foeman race, they have passed away, leaving behind them no story or tradition to give a clue as to what manner of men they were.

The Mound Builders were immediately followed by a race of fishermen, solely riparian in their habits, and who procured their principal food from the rivers, while they cultivated a few domesticated plants.

Finally came a savage race of nomads with the wandering habits, the cruel mode of warfare, the custom of scalping, the habit of making sepulchral mounds, so characteristic of the wild men of Scythia, and which may be traced along the whole line of march from ancient Scythia to the heart of America. With this race no extensive earth works were made, no large monumental remains exist of their erection. Averse to labor, the males were addicted only to war and the chase, leaving to their women the ordinary toils of agriculture and home. But the red man, too, is passing away. Only the barbarities of the worst of his race are remembered, while every generous act of hospitality and kindness, every noble deed of heroism in defense of people and country, even the eloquent pleas of their orators for existence, are forgotten, and but few can recall the expressive names given by them to their villages, streams and localities.

The map here presented gives the Indian names to the rivers, creeks, etc., of Indiana, and it represents a heavy expenditure of money and time. The late Daniel Hough, of Wayne county, so favorably known throughout the State, and who so earnestly

enlisted his sympathy and labor in rescuing these facts as a palimpsest of the past, merits the credit, and deserves the highest honor for this labor of love.

The Indian names are given in *Italics*, and the common names in Roman letters.

The family of Daniel Hough, deceased, have permitted the publication of this map by the Geological Survey, as their contribution to the *Archæology of Indiana*, and the hearty thanks of the State Geologist are hereby rendered. The family still retain the copyright.

This map is a beginning. It may possibly have a few faults. It is hoped that our friends throughout the State will make additions and corrections to the State Geologist, giving in particular, the meanings of the names, with the name of the tribe from whose language they are drawn—whether Miami, Pottowattomie, Shawnee, or Delaware, etc.

In addition to the foregoing map, so carefully prepared by Daniel Hough, the State Geologist is indebted to the Hon. H. W. Beckwith, of Danville, Ill., for the following additional list of Indian names for the streams and lakes of Indiana, with notes on the relations of the different tribes, nations and languages prevalent in Indiana, as also the meaning of the Indian names.

Mr. Beckwith is enabled to furnish this valuable and important addition to our knowledge of the early history of the native races, by reason of years of labor spent in preparing his interesting work on the aboriginal history of Illinois, Indiana and the great Northwest. Not only years of time, but large sums of money have been by him expended for rare and costly books, as well as in visiting and studying the great central libraries of our country.

The State Geologist acknowledges, with liveliest gratitude to Mr. Beckwith, this valuable contribution to American knowledge.

## INDIAN NAMES OF WATER COURSES IN THE STATE OF INDIANA.

BY H. W. BECKWITH, ESQ., DANVILLE, ILLINOIS.

**THE MAUMEE.**—By the Shawnees was called "*Ot-ta-wa-se-poié*," that is Ottawa river; reason, Ottawa Indians had villages upon its banks. The Wyandots called it "*Cagh-a-ren-du-teie*," "River of-the-Standing-Rock," because of a prominent rock that stood in, or near, the stream in the vicinity of Maumee Rapids. *Vide* John Johnson's Account of Indian Tribes, etc., published in vol. 1, "Archæologia Americana."

**THE ST. MARY'S.**—By the Shawnees was called the "*Co-koth-e-ke-se-poié*," that is, Kettle river. Reason not given. Same authority.

**THE WABASH.**—From two Algonquin words "*Wau-ba*," (White) and "*Wa-bish*," (Water). "*Wau-bish*," *i. e.*, White river. Iroquois name, "*Qui-a-agh-te-na*," French name "*Ouabach*," though that is truly the name of its south-eastern branch (the present White river.) *Vide*, map of Lewis Evans, published in 1755.

**THE MISSISSINEWA.**—From the two Algonquin words "*missi*" and "*as-sin*," [with termination *ewa* given to indicate inanimate objects, or for the purpose of euphony,] signifying the "River of Much (or Great) Stones," as your Geological Report amply confirms. *Vide*, your Geology of Miami County.

**TIPPECANOE.**—Says Rev. Isaac McCoy, Baptist Missionary among Wabash Tribes, "the Indian pronunciation is '*Ke-tap-e-ton*.' It does not embrace the word canoe as many suppose. With slight variations in the different dialects spoken in that region, the name for 'canoe' is '*chee-man*.'" McCoy does not give meaning of "*Ke-tap-e-ton*,"—the root of the word however, is "*Ke-non-ge*," or "*Ke-no-zha*," meaning the long-billed, or walled-eyed pike, that is Pike or Pike-fish river. *Vide*, serial Algonquin Vocabularies and Flint's Geography of Western States, published in 1828.

RED-WOOD CREEK.—“*Mus-qua-me-tig-se-pe*,” from the compounding of the two Ojibeway Algonquin words, “*Mus-qua*,” [Red], and “*Me-tig*,” [Tree, or Wood], literally Red-wood Tree river. *Vide*, Prof. Keating, in Long’s Expedition through Indiana and Illinois, in 1823.

PINE CREEK.—In the same dialect, [for it must be borne in mind that when the whites first came in direct contact with the natives of Western Indiana, the entire country west of the Wabash and north of Pine creek (which stream was then the north boundary of the territory of the Kickapoos), was occupied by the Pottowattomies, who were one of the three tribes composing the great Ojibeway, or Chippewa confederacy, and who gave their names to the streams, and in many instances it is only these that are left to us. Hence, we often look to the Ojibeway, instead of the Miami Algonquin dialect, for the root and signification of names. One of the most difficult problems the Ethnologist encounters in deciphering aboriginal names, is to first determine the dialect. Is it Shawnee? Miami? Illinois? or Ojibeway? All Algic, or Algonquin, yet each having its peculiar, and in many instances, radical differences. And it is here that our friend, Judge Hough, was often at fault. Again, white men with no scientific attainments, and who gave Indian names, and their rendering, are the poorest and least reliable sources of authority, as I have often found], is “*Puck-gwunnash-ga-muck-se-pe*,” literally the “White-Pine-Tree-of-the-Bark-Peeling-Kind.” *Vide*, Prof. James’ Vocabulary.

WILDCAT.—Wildcat is “*Pish-e-wa*.” It so happens that in the Shawnee, Ojibeway and Miami dialects this is the common word for the same animal, the wildcat. “*Pish-e-wa*” was also the Indian name of the last great chief of the Miamis, Godfrey Richardville, whose late village, and where he died, was upon the “*Mississenewa*,” near Peru.

KANKAKEE.—“*The-a-ki-ki*,” from the two words, “*the-ak*” (wolf) and “*a-ki*” (land), literally, “Wolf-land river,” from the fact that many years since a band of Indians of the Mohegan tribe, who called themselves Wolves, being driven from their ancient home by the Iroquois, took refuge on its banks. *Vide*, Father Charlevoix’s Narrative Journal, containing his voyage down the Kankakee river in 1721. (It was from some of these

Mohegans, at whose village a few miles southwest of South Bend, he recruited his forces for his expedition down the Kankakee, Illinois and Mississippi rivers.)

IROQUOIS.—So called prior to the year 1700, because of a defeat of a war party of Iroquois upon its banks by the Illinois Indians, the only instance in which the Iroquois were ever defeated in their exterminating wars upon the Illinois. By the Kickapoos it was called "*Mock-a-bel-la*," a French-Canadian corruption of a compound word, the root of which is "*mo-qua*" (bear). Again, the Commissioners of Indiana and Illinois appointed to run the boundary line between the two States, in their report in 1821, give it the name of "*Pick-a-mink*" river. At this period the Pottowattomies had exclusive possession of the entire country drained by this stream. Knowing this, and allowing for carelessness of average writers in Indian names, the signification is easily attained. "*Ah-mik*" is the Pottowattomie for beaver, while "*pah-ka-mik*" is the name of a full-grown beaver; hence "*Pick-a-mik*," or, more properly, "*Pah-ka-mick*"—Beaver river. There is a tributary of the Iroquois called Beaver creek, to which I remember to have heard old settlers prefix the word "little," and it is natural that the Indians should have called the Iroquois the Full-Grown-Beaver river.

BEAVER LAKE.—In this connection we have a very sure footing for the aboriginal name of the once beautiful Beaver lake, now growing corn as abundantly as it originally produced the beaver. "*Sag-a-yi-gan*" (a lake) and "*uh-nick-yug*," (the "yug" added to the "uh-nick" being the plural number of beaver.) "*Sag-a-yi-gan-uh-nick-yug*" the lake of the beavers.

WHITE RIVER.—By the Delawares, who for many years lived in the part of Indiana drained by White river, this stream was called the "*Ope-co-mee-cah*." Vide their own statement of their country and its boundary at a treaty which is copied in Hildreth's Pioneer History.

VERMILLION.—By the Miamis called "*Pi-awk-e-shaw*." The word "*Pi-awk-e-shaw*" was descriptive of a red earth, known under the provincial name of red-keel, produced by the burning of the shale overlaying the outcrop of coal, the latter ig-

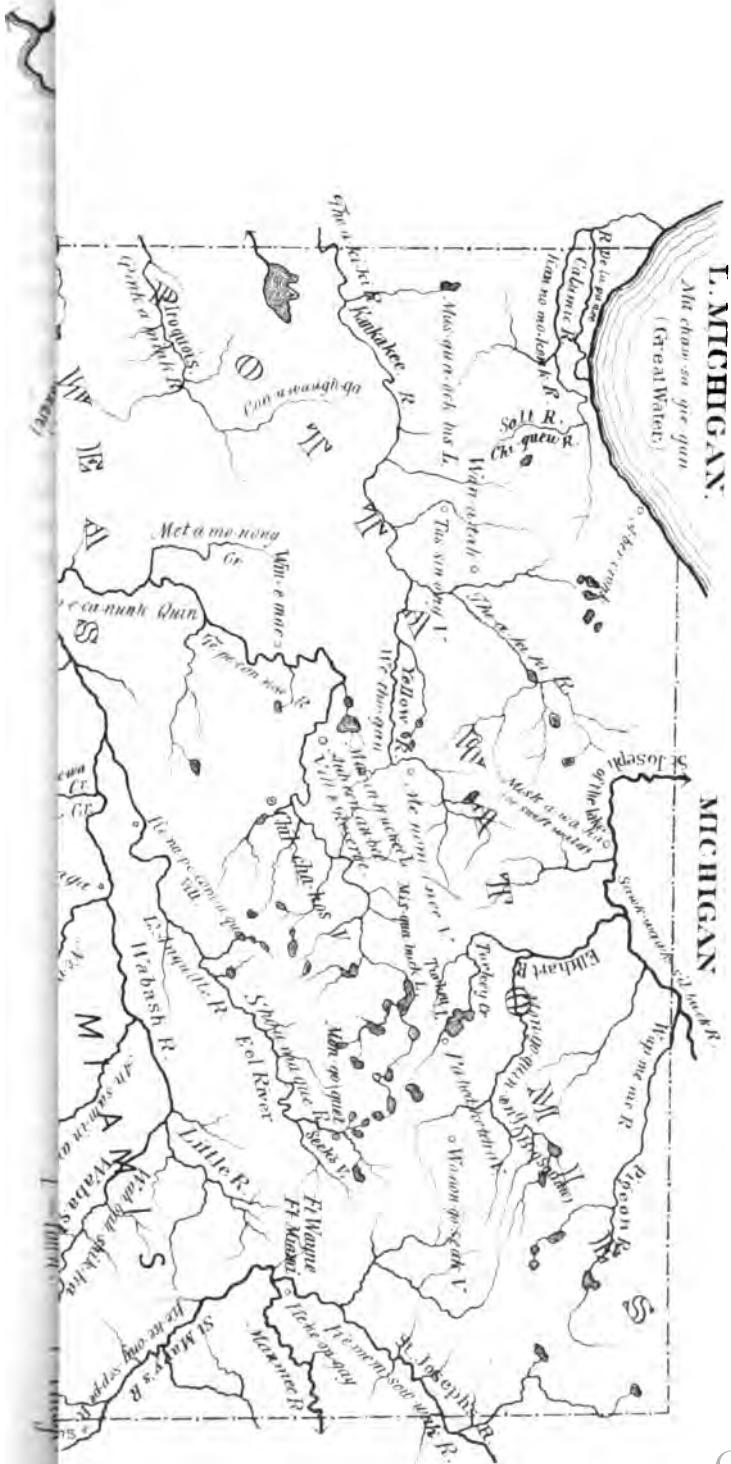


niting from the autumnal fires. This chalk, or calcined shale, is found in great abundance along the streams, and the Indians used it as paint. The signification is preserved in the French word, Vermillion, synonymous with the English word, Vermillion. The name "*Pi-uk-e-shaw*" is recorded in documents of the French when in possession of this country, more than a century and a half ago. A band of the Miami tribe, who occupied the country along the waters of the Vermillion, were called "*Pi-uk-e-shaws*" for that reason. In time they were called the upper "*Pi-uk-e-shaws*," or Vermillions, to distinguish them from members of the same sub-tribe, occupying both sides of the Wabash, near Vincennes. The river gave the name to this tribe of "*Pi-uk-e-shaws*"—not they their name to the stream—the same as the Eel river gave its name to another tribe of Miamis who lived upon its waters.

On your map I have lengthened out with a pencil mark the Vermillion river, to give it the prominence which it historically deserves. It was the boundary for many years between possessions of different tribes, and during a period of its ownership by France, the Vermillion was a part of the boundary between Canada and Louisiana.

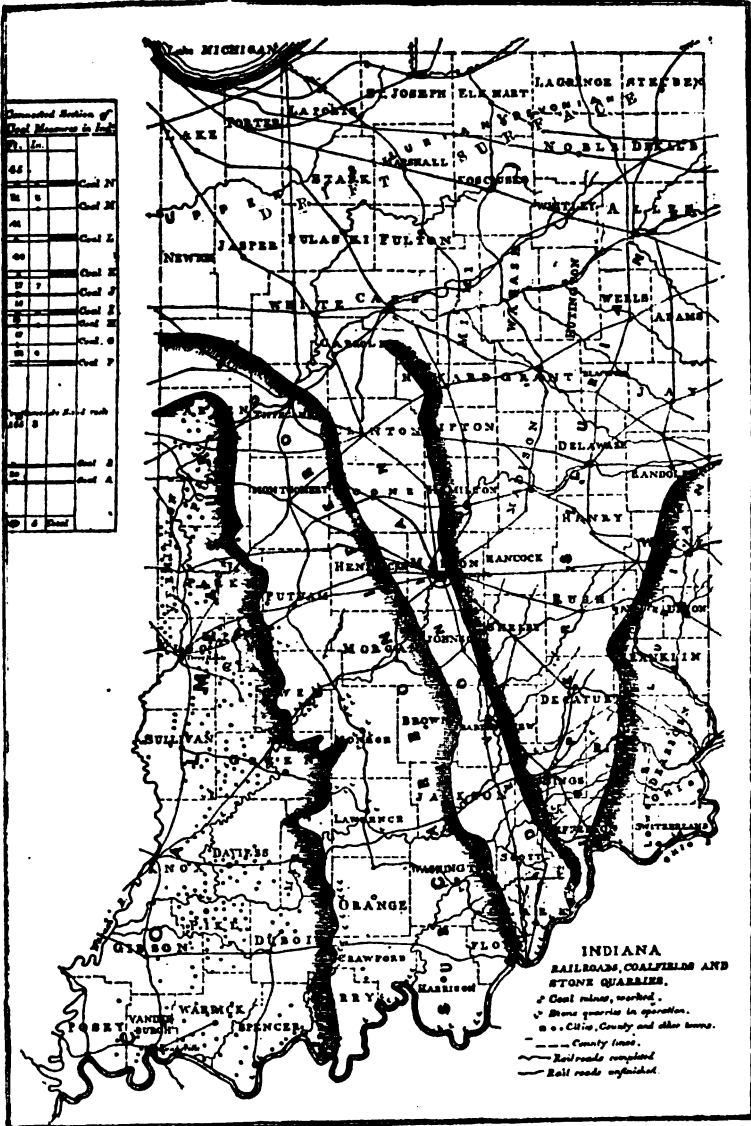
**EEL RIVER.**—In the Ojibeway dialect is "*Ke-na-be-gwin-maig*," (the "*maig*" being the plural,) a free translation of which is Snake-fish river. I have left off the "*Se-pe*," or term for water course.

**THE OHIO.**—This name can not be improved upon. It was given by the Iroquois, sub-tribes of Southern New York, living on the Allegheny branch, who called it "*O-i-o*," meaning "beautiful"—a name perpetuated in the French, "*La Belle*." This nation used the Ohio as a means of transit in their conquests over the Shawnees, Chickasaws, and other tribes. There is another name by which this river was called, not generally known, and which is of vastly more historical importance, and only recently brought to light in the translation of Father Gravier's manuscript letter of a voyage made by him down the Mississippi, in the year 1700. With his attention directed especially to the subject, and for the purpose of clearing up the confusion produced by other writers with reference to the Ohio and its tributaries, he distinctly observes that the Ohio, by





both the Allianies and Illinois, was called the river of the "*A-Kan-Sea*," because the *A-Kan-Seas* formerly dwelt upon it. This fact ought to be preserved. The earliest French explorers found the *A-Kan-Seas* lower down the Mississippi, near the mouth of the Arkansas. They were the most skilled of all aboriginals in weaving and painting cloth, making glazed pottery, and erecting mounds for their sun or fire worship. All these facts will probably form a basis of better theories as to the ancient earthworks on the Ohio, below and above Marietta. I would suggest that the Ohio of the Iroquois and *A-Kan-Sea* of the *Miamis* would be a better duplicate of names for the Ohio river than the *Eagle* river of the *Delawares*, or *Turkey* river of the *Shawnees*, who were latter day Saints upon its borders, neither of whom were in Ohio until long after the stream had become known to the French as well as English colonists.



## OUTLINE GEOLOGY OF INDIANA.

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The outline geological map of the State, printed herewith, is upon so small a scale that it must be regarded as merely a rough sketch. It shows, however, with reasonable accuracy, the surface exposures of the rocks of the several geological formations. An extended description of each of the general strata with a section illustrating the same might have been advantageously added to the present Report, but circumstances permit of only the following brief statement, embracing a list of the counties in which the several strata are found.

### LOWER SILURIAN.

The rocks of the Lower Silurian age, known as the Hudson river or Cincinnati group, are found in the southeastern division of the State, extending also throughout large areas in Ohio and Kentucky. They are well exposed in the bluffs of the Ohio river, extending west to the mouth of Fourteen-mile creek, in Clark county, and form the surface rocks in the counties of Wayne, Union, Fayette, Franklin, Dearborn, Ohio and Switzerland. In several of the adjoining counties to the west are exposures of lower Silurian in ravines and deep cuts, as on the extreme east side of Clark, Jefferson, Decatur, Rush, and in the southeastern part of Randolph counties. The rocks of this formation are filled with well-preserved fossils, and in decomposition form a rich and highly productive soil.

### UPPER SILURIAN.

Strata of the Upper Silurian formation form the general surface rocks of the counties immediately west and northwest of those in the lower Silurian, including Adams, Wells, Hunting-

ton, Wabash, Miami, part of Jasper, White, Cass, part of Carroll, Jay, Blackford, Grant, part of Howard, Delaware, Madison, the eastern parts of Tipton and Hamilton, Randolph, Henry, Hancock, Rush, Shelby, Decatur, the eastern part of Marion, Bartholomew, Jennings, Jefferson, and the eastern parts of Scott and Clark counties. The upper Silurian strata also extend north and northwest from these counties to the northern boundary of the State, at many points being locally capped by uneroded areas of Devonian age, but the Silurian is so deeply covered with boulder drift as to be rarely seen, and its presence is more known by test bores than by outcrops in the drift district.

Soils derived from the disintegration of rocks of this age are, as a rule, cold, heavy clays, which, when drained, produce good crops of wheat and the grasses.

#### DEVONIAN.

The Devonian rocks are exposed in a narrow band, commencing on the south at the Ohio river in Clark and Floyd counties, and extend thence north and west through the counties of Scott, Jackson, Bartholomew, Johnson, Marion, Boone, Clinton and Carroll, with local exposures in Tippecanoe, Cass, White and Jasper, Miami, Wabash, parts of Shelby, Jennings, Jefferson and Jackson. From fossils collected in the drift area to the north and west, and from test bores, it is known that Devonian rocks have been more or less eroded, but once covered much of the northern third of the State, and at many points they are still in place.

#### SUB-CARBONIFEROUS OR MOUNTAIN LIMESTONE.

Rocks of the Sub-Carboniferous series form the surface strata in a wide belt west of the Devonian and east of the coal measures, and these, for the most part, constitute the rocky exposures of the counties of Harrison, Crawford, Orange, Washington, Lawrence, Brown, Monroe, Owen, Morgan, Putnam, Hendricks, Montgomery, Tippecanoe and Benton, with parts of Perry, Floyd and Jackson. The eastern line of this belt is composed of shales and sandstones of the Knobstone group, while adjoining on the west are the great cavernous limestones

of the State, so well exhibited in the southern counties, but which thin out to a few feet at the north. The soil of this district is remarkable for its growth of cereals and grasses.

COAL MEASURES.

The rocks of the coal measures are found in the counties of Posey, Vanderburgh, Warrick and Spencer, the western parts of Perry and Crawford, in Gibson, Pike, Dubois, Knox, Daviess, Martin, Sullivan, Greene and Clay, the western part of Owen, and in Vigo, Parke, Vermillion, Fountain and Warren, with a projection in a narrow band of coal measure rocks (Conglomerate sandstone), underlaid by thin beds of Keokuk limestone and Knobstone shales of the Sub-Carboniferous group, extending from the northern part of Warren county, in a northeasterly direction across Benton and terminating near Rensselaer, in Jasper county, where the Conglomerate is massive. It is probable that this projection is not continuous, but interrupted at intervals.

It is apparent, therefore, that the lower Silurian, being the oldest rocks brought to the surface, underlie all the more recent rocks which in succession have been deposited upon or about it during the different ages of the earth's existence. A shaft or bore put down in the western part of Gibson county would pierce in succession all the geological formations of the State, and would show the approximate depth of each to be as follows:

*General Section.*

Coal measures.....	725 feet.
Sub-Carboniferous .....	680 "
Devonian.....	200 "
Silurian.....	3,000 "
	4,605 "
Total.....	4,605 "



## GEOLOGICAL SURVEY OF NEWTON COUNTY.

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Newton was one of the last counties organized in the State. Situated in the midst of the great northwestern prairie district of Indiana, it long formed a part of Jasper county, and it was not until 1860 that it was organized separately. It is bounded on the north by Lake, on the east by Jasper, south by Benton county, and on the west by part of the eastern boundary of the State of Illinois.

Kentland, the county seat, is situated on the Logansport and Peoria Division of the P., C. & St. L. R. R., and is about one hundred miles northwest of Indianapolis, five miles from the Illinois line, and two miles from the southern boundary of the county. The only other towns of any size are Goodland, in the southeastern corner, and Morocco, near the center of the county.

Newton county contains 400 square miles, of which the number of acres subject to taxation is 252,079, with an additional area of wet and swamp lands, in part belonging to the State, and not taxed, of about 2,000 acres, making a total of 254,079 acres.

The whole of this area was originally about 66 per cent. prairie, and at that time the number of acres in good timber was about 60,000; to which may be added about 25,000 acres of brush and small timber.

The Kankakee river flows from east to south of west along the whole of the northern boundary, forming the dividing line between it and Lake county. Throughout its whole course it is sluggish and tortuous. The Iroquois river flows across the county in a nearly west direction, through the southern half, while Curtis creek flows in a general southeasterly direction

near the east central part, joining the Iroquois in Jasper county, and Beaver creek (the former outlet of Beaver lake) runs south and west through the central parts into the State of Illinois.

These were originally strong streams of water, with a full flow, generally yellowish in color, from the decay of vegetable matter on its banks and from the iron in the marshes and swamps, while from the present constant source of supply of water they are not addicted to extreme very low stages or to sudden overflows. Their waters being of gentle current and muddy bottoms, are well adapted for the homes of non-migratory fishes, especially of the lake type; hence the Kankakee, Iroquois, and other streams are the delight of fishermen, who are rewarded with the best and brightest of the finny race.

Beaver lake, near the central part of the county, was formerly drained in a south and west direction by Beaver creek. Its original area was about 25,000 acres, having a depth of from two to six feet, averaging about three and a half feet. It was drained by the State ditch from its northern extremity into the Kankakee river, and now the area covered with water is less than 1,000 acres. Of this original lake bed, 2,500 acres are at present in cultivation, while the balance is being rapidly drained and prepared for tillage.

Little lake, in the southwestern, and Mud lake, in the northwestern corner of Colfax township, are smaller bodies of water, lying south and east of Beaver lake.

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## SURFACE CONFIGURATION.

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The general aspect of the county is a great plain, being an elevated plateau well up toward the summit of the glacial drift.

Since, and during that epoch in geological history, the surface has been molded by sluiceways from melting ice and the waters of the present actual streams, formerly in greater volume. This has resulted in the formation of wide valleys, through which all the streams flow, with intervening ridges of from fifty to eighty feet above the valley centers.

The ridge dividing the waters which flow into the Iroquois from those of the Wabash system, is close to the southern boundary of the county. Another important ridge, not quite so well defined, divides the Iroquois from the Kankakee.

These ridges afford ample facilities for the drainage of the northern and central districts; which will be treated further on, under the head of "Economic Geology."

In the northern third of the county, the soil is largely composed of loose sand; hence, while it is not so well adapted to ordinary agricultural purposes, yet for special crops, with manures, it has been found productive and profitable.

This last district is palpably lacustral in its characteristics. Sloughs, swamps and marshy thoroughfares indicate the old beds of lakes, while the sandy divides between them show the ancient shore lines. But, significant of that time of many lakes, the whole region is traversed by sandy ridges on the northeastern shore of such lakes, having an invariable trend from northwest to southeast, with sloping sides to the southwest, and abrupt banks to the northeast. Heretofore it has been supposed that these were simply the shore lines of such bodies at different stages of water.

The foregoing circumstances, however, added to a careful examination of the fact that these sand ridges are not laminated as by a deposit by water, show that their origin is due to other causes.

The prevailing summer and autumnal winds at that time, as at present, were from the southwest. It is well known that loose sand is rapidly and powerfully drifted before a strong wind, as is seen at the "Hoosier Slide" and adjoining regions at Michigan City, as well as in the donnes or sandy lands of France. Hence, in the direction from which the winds came, the slope of these sand ridges faces toward the southwest, and their abrupt bank is opposite to it, or toward the northeast.

At occasional points, where an uninterrupted wind impinged against these ridges, or where the grass and brush had been removed by Indian encampments, or by the passage of herds of buffalo, a break would occur upon the surface; the loose sand would be subjected to the action of the winds, and portions of such ridges would be blown away, to be built up in the shape of new ridges, or mounds and hillocks, leaving behind cup-

shaped basins or hollows, at the place of removal. Instances of such action may be seen all along the eastern and southeastern ridges surrounding Beaver lake. These knolls and sharp conical mounds naturally attracted the attention of our mound builder predecessors, and are sometimes mistaken for their own handiwork.

On the divide between the Kankakee and the Iroquois are ridges, knolls and areas, underlaid by good beds of gravel, which had scarcely been noticed until the time of my visit. This matter, of considerable practical value, will be noticed under the head of "Economic Geology."

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### RECENT GEOLOGY.

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The surface of the county is so deeply covered with soil, sand and loam, which had their origin in causes still in action, such as lake, river and pond deposits, that but little study is afforded of the greater modifying causes of the glacial and ancient lacustral epochs. The presence of the great ice drift is attested by the bowlders, gravels, and imported rocks from the distant North, as seen in the ditches and hillsides of this region, as well as occasionally in the open prairies. The deep wells throughout the county pierce the great bowlder drift or clays of the "Ice age," and there is found a constant bed of this material covering the underlying rocks to a depth of from 60 to 150 feet or more. This would indicate that powerful denuding currents swept from east to west over the county, cutting out deep, wide valleys in the rocky beds below, and removing remarkable amounts of stony material.

Following upon this came the great northern ice flow, which filled up these valleys, and deposited its immense burden of clay, bowlders and gravels upon the surface to the depths mentioned above.

The phenomena of these ancient erosions and denudations and the replacement of the surface of the county are indicated by the following sections of bores and deep wells:

*Section in Alex. J. Kent's Well.*

Section 22, township 27 north, range 9 west, one mile north-east of Kentland, bored 1869 and 1870.

Soil, black.....	2 ft. 06 in.
Gray clay, bowlders.....	10 00
Boulder, blue clay.....	70 00
The same, with partings of sand and fine gravel..	100 00
Black slate, with bituminous partings.....	70 00
Devonian limestone.....	20 00
Upper Silurian limestone.....	48 00
Total.....	<u>320 ft. 06 in.</u>

*Section in Kentland Well, Public Square.*

Section 21, township 27 north, range 9 west.

Soil.....	2 ft. 00 in.
Blue glacial clay.....	148 00
Black slate.....	73 00
Devonian limestone.....	25 00
Upper Silurian limestone.....	120 00
Total.....	<u>368 ft. 00 in.</u>

Water flowed at 300 feet.

*Section at Kent's Warehouse, Kentland.*

Section 21, township 27 north, range 9 west.

Soil.....	2 ft. 00 in.
Blue boulder clay.....	80 00
Black slate.....	80 00
Total.....	<u>162 ft. 00 in.</u>

No water.

*Section at Kent's Farm, Two Miles Southwest of Kentland.*

Section 29, township 27 north, range 9 west.

Blue clay.....	50 ft. 00 in.
Hard limestone.....	00 00
Total.....	<u>50 ft. 00 in.</u>

*Section at Kent's Farm, Four Miles Northeast of Kentland.*

Section 18, township 27 north, range 8 west.

Blue clay.....	50 ft. 00 in.
Water, in limestone.....	3 00
Total.....	53 ft. 00 in.

*Section at Besicker's.*

Section 14, township 28 north, range 10 west, 8 miles north-west of Kentland, 1½ miles east of State line.

Soil.....	3 ft. 00 in.
Yellow clay.....	6 00
Blue glacial clay.....	156 00
Gravel and sand.....	6 00
Total.....	171 ft. 00 in.

*Section at Mark Petersen's Farm, Eight Miles Northwest of Kentland.*

Section 11, township 28 north, range 10 west, half a mile east of State line.

Soil.....	2 ft. 00 in.
Yellow clay.....	6 00
Blue boulder clay.....	154 00
Fine gravel.....	6 00
Sand.....	2 00
Total.....	170 ft. 00 in.

*Section at P. Strickler's, Ten Miles West-northwest of Kentland, Half a Mile West of State Line.*

Soil.....	8 ft. 00 in.
Yellow clay.....	4 00
Yellow sand.....	1 00
Blue boulder clay.....	117 00
Black slate.....	25 00
Limestone, Devonian.....	35 00
Limestone, Silurian.....	10 00
Total.....	195 ft. 00 in.

*Section on Same Farm.*

Soil.....	3 ft. 00 in.
Blue clay.....	122 00
Water, in black slate .....	1 00.
	126 ft. 00 in.

Other wells in the adjoining regions of Illinois give slate and limestone at 110 to 125 feet, showing the deep erosion of the ancient Valley of the Iroquois from northeast to west-southwest, and invites drainage in that direction.

*Section at W. C. Russell's.*

Section 14, township 28 north, range 10 west, 8 miles north-west of Kentland.

Soil and drift .....	125 ft. 00 in.
Black slate.....	10 00
	135 ft. 00 in.

*Section at J. V. Speck's.*

Section 13, township 27 north, range 10 west, 5 miles north-west of Kentland.

Four wells, 55 to 86 feet in blue clay; wood and plant remains, with brown swamp muck at bottom.....	80 ft. 00 in.
Sand and gravel.....	6 00
	86 ft. 00 in.

Did not go down to slate or stone.

This would indicate the ancient or early river bed south of Speck's and north of Kentland.

In the Iroquois valley many wells have been bored close along the stream; all of these, so close to the river that the high water backs up to them, flow the year round. All are charged with iron and some with burning gas.

*Average Section in Wells, Four Miles North of Kentland.*

Soil.....	2 ft. 00 in.
Quick sand.....	12 to 15 00
Blue clay.....	30 00
Hard-pan gravel.....	5 00
Blue sand.....	4 00
	—
Total.....	56 ft. 00 in.

This average section indicates a great thickening of fluviatile deposits, and suggests the possibility that the channel of the Iroquois is being filled up.

*Section at Isaac Eastburn's.*

Section 23, township 27 north, range 10 west, 4 miles west of Kentland at State Line.

Black soil.....	3 ft. 00 in.
Yellow clay.....	6 00
Blue glacial clay.....	25 00
Blue glacial clay with partings of sand.....	46 00
Gravel and fine sand.....	3 00
	—
Total.....	83 ft. 00 in.

The foregoing wells were bored by David McKenzie, to whom the Survey is indebted for the statements here given.

*Section—Average of Twelve Wells Bored by Hyer Brothers in and near Kentland.*

Soil.....	2 ft. 00 in.
Yellow clay.....	10 00
Blue glacial clay.....	45 00
Sand, sharp.....	2 00
	—
Total.....	59 ft. 00 in.

Water rises to within eighteen or twenty feet of the surface.



*Section in Drake's Well.*

Section 25, township 27 north, range 9 west.

Soil.....	1 ft. 00 in.
Yellow clay.....	12 00
Blue glacial clay.....	20 00
Gravel and sand.....	2 00
Total.....	35 ft. 00 in.

Artesian flow.

*Section at Ed. Brush's, Three Miles Southwest of Kentland.*

Soil.....	2 ft. 00 in.
Yellow clay.....	7 00
Sand and gravel.....	4 00
Blue clay.....	68 00
Hardpan gravel.....	4 00
Limestone.....	1 00
Total.....	86 ft. 00 in.

In this bore, artesian water rises to level of the ground.

*Section at Ezra Jones', near Brook, Eleven Miles Northeast of Kentland.*

Soil.....	2 ft. 00 in.
Yellow clay and sand.....	10 00
Blue glacial clay.....	45 00
Sand.....	1 06
Rock bottom.....	00 00
Total.....	58 ft. 06 in.

*Section in Gas Well, Francis Lowe's, One-Quarter Mile Southwest of Kentland.*

Soil.....	2 ft. 00 in.
Yellow clay.....	10 00
Blue clay.....	45 00
Quicksand.....	12 00
Black slate bottom.....	00 00
Total.....	69 ft. 00 in.

Burning gas was discharged with violent periodic bursts, throwing sand and water thirty feet in the air. When gas was discharging, the tube trembled with agitation, and the outer tube became electrified, giving shocks.

Another gas well in the town continued to discharge for twelve years.

From these bores it is evident that the ancient valley of the Iroquois river existed one to two miles south of its present bed, and had a depth below the surface from 150 to 200 feet, deepening to the west. It is also known by a bore near the south line of Iroquois county, Illinois, that one of these ancient east-west valleys had a depth of 500 feet through soil and boulder drift to its rocky bed.

These indications seem to show that a new bed for the Iroquois, opened one or two miles south of the present channel, and produced across the line to some watercourse 100 to 150 feet lower than the present surface of that valley, would cut for itself a deep channel through the clay sub-stratum, drain this and adjoining regions to the east, and benefit the citizens of this section of country, and the State of Indiana, to the extent of millions of dollars.

At the thriving village of Morocco, Lowden & McCorcle have established an extensive creamery for the manufacture of butter and the shipment of that product and milk to the Chicago markets. A good supply of fresh water was necessary, hence a bore for a well was being put down, but unfinished, when visited.

*Section in Well at Morocco.*

Yellow clay.....	14 ft.	00 in.
Blue clay.....	113	00
Niagara limestone to bottom.....	9	00
Total.....	136 ft.	00 in.

## PALEOZOIC GEOLOGY.

As before mentioned, nearly the whole surface of this county is deeply covered with glacial drift impenetrable to the geologist's eye. It is known from the geology of the adjoining regions to the north, and from deep bores, that the northern part of the county is underlaid with Niagara limestone of the Upper Silurian age; that the Valley of the Iroquois is underlaid by Genessee shale (or black slate) of the Devonian age. Inferentially, the southern portion of the county should be underlaid by rocks of the Upper Devonian Groups, or of the Sub-Carboniferous age.

But three and a half miles southeast of Kentland the rocky beds come to the surface, or nearly approach it, over an area of more than 100 acres. At one of these exposures the bedding is nearly horizontal—at the other, in close proximity, the rocks were in nearly a vertical position, with a north-south trend, showing either serious dislocations or deposition under circumstances which gave origin to the most pronounced false bedding.

At the latter station the stone was a slightly crystalline, bluish-gray limestone, with great nodules of *cone-in-cone* one to two feet in diameter, indicating pressure of superimposed material while it was in a plastic condition.

At the time of my first visit, accompanied by Assistant George K. Greene, after a most careful and thorough search, not a single fossil, or fragment of a fossil, was found which could determine the age of these rocks.

On a subsequent visit, Mr. Greene was able to find, at one of these—McKee's Quarry (Sec. 25, T. 27 N., R. 9 W.)—some slabs, containing the following fossils:

<i>Tetradium fibratum</i> .....	Safford.
<i>Zygospira modesta</i> .....	Say.
<i>Streptorhynchus</i> .....	Sp.?
<i>Leperditia</i> .....	Sp.?
<i>Ptilodictya</i> .....	Sp.?
<i>Orthoceras</i> .....	Sp.?

Fragments of stems of *Glyptocrinus*.

These fossils indicate that the rocks are Silurian, and probably of Lower Silurian age. The mass is too large to admit of explanation by its transportation during the Ice period; while the uniform, undisturbed condition of the strata of this and adjoining States will not allow the presumption of upheaval and such dislocation of strata as would account for these phenomena.

As shown by the bores reported, it is surrounded to the north and west, and at levels 150 to 200 feet lower than this point, by later Devonian shales and limestones; on the south and east, still at a lower level, are the rocks of the Keokuk Group of the still later Carboniferous age.

This quarry is a mystery. Its investigation invites and will reward the future geologist, who may be enriched with better light than is now available. At present the only explanation which can be here given is that once the Silurian rocks of this and adjoining regions may have been built up to a thickness of 200 or 300 feet more than they are at present, and that eroding forces at the close of the Silurian age removed all the upper beds of that age to a depth of 200 or 300 feet, leaving this small area an immovable island in the surging waters, and afterwards the later Devonian and Carboniferous beds were deposited around and against the sides of this monumental island. More light and research is needed and invited.

Near Goodland, eight miles east of Kentland, the following exposures occur upon Cherry creek, which show the occurrence of the Keokuk and Knobstone shales of the Sub-Carboniferous, and the black slate of the Devonian rocks.

*Section on Blake Wilson's Farm, Grant Township.*

Section 25, township 27 north, range 8 west.

Buff and light-colored limestone (Keokuk), containing Geodes, fragments of Crinoid stems and Bryozoans.....	12 ft. 00 in.
Knob shale with <i>Discina newberryi</i> and <i>Lingula spatula</i> .....	5 00
Total.....	17 ft. 00 in.

*Section on William Foster's Farm.*

Southwest one-half of section 25, township 27 north, range 8 west.

Blue clay and shaly limestone (Keokuk group), containing Geodes, geodized shells and Crinoid stems.....	4 ft. 00 in.
Ferruginous sandstone, containing <i>vermiform fu-</i> <i>coids</i> and <i>Taonurus</i> .....Sp?.....	6 00
Total.....	10 ft. 00 in.

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### ARCHÆOLOGY.

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Stone implements of the Prehistoric age are often found scattered over this county, more especially those used for the taking of fish. While the sand-hillocks and knolls of the northern part of the county are often mistaken for works of the Mound Builders, it is true that many such elevations have been capped by the homes and tumuli of that race. The elevated sandy ridge east of the southern part of Beaver lake, built up by the winds to a height of seventy or eighty feet, which gives a wide outlook toward the rising sun and a grand view of the lake in its ancient dimensions, was extensively occupied by the Mound Builders.

Several clusters are reported, one of which contained seven mounds from two to twelve feet in height, and from twenty to eighty feet in diameter. Partially explored, two of these gave up bones, pottery and implements of our extinct predecessors.

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### ECONOMIC GEOLOGY.

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#### SOIL.

The soil of the southern half of the county is a rich, black pond alluvium or mold, varied by areas of loamy soil. It has been enriched and manured by the decomposition of plants for

thousands of years, and is fully equal to the richest and best lands of the world. No manures are used or required. Since the first settlement, these farms, instead of deteriorating, have increased in productive power, and will continue for years to grow richer and better as the country is improved. The oldest fields of the county were seen bearing full crops of corn, oats, and other cereals, while it is even better adapted to the growth of grazing and meadow grasses.

The citizens are generally prosperous, as indicated by comfortable residences and improved farms.

The northern areas, as before mentioned, are sand ridges, sandy loams, with intermediate alluvial lake basins. These need special treatment, and are being cultivated by immigrants from Chicago and the East with astonishing success.

#### DRAINAGE.

To enable the farmer to reap full returns from the rich soil above mentioned, drainage is a necessity. The alternate ridges and valleys of this county afford a certain mode of effectually bringing these soils to the highest state of cultivation by the facilities they offer.

A plan devised by a competent engineer—running open ditches from the southern part of the county to the Iroquois, or from the northern ridges to the neighboring streams, located upon each north-south section line, and cut down to the underlying clays, will, by their pronounced fall, continually deepen and clear their own way. These will afford ample facilities for the use of tiles on adjoining lands, make improved roads possible along their banks, and bless the people of the county with bountiful returns of health, wealth, and their concomitants—intelligence and morality.

Bores in deep wells show that the ancient valley of the Iroquois, a short distance south of its present course, was in early ages deeply eroded, and when a new course is reopened through this channel, as in the future it may and will be, it will offer ample facilities for the drainage of all the center of this and the southern parts of Jasper county.

## RAILROAD FACILITIES.

The Logansport & Peoria branch of the P., C. & St. L. Railroad gives facilities for the shipment of produce and the importation of coal and other necessary commodities through the southern half, while the Chicago & Indianapolis Air Line traverses the northeastern part of the county.

The Goodland & Chicago Railroad, now in process of construction, passes through the eastern parts, and another line is projected by way of Kentland, north, through the center of the county. The proposed Continental Railroad passes in an east-west course along the Iroquois Valley. These roads will afford abundant facilities for external commerce.

## ROADS.

In time of wet weather the roads of this county are simply abominable, and deny the citizens the proper enjoyment of civilization, the fruits of labor and social life.

With the system of open ditches before mentioned, a possible road bed is attainable. The stone of McKee's quarry, when properly broken, will afford abundant material of excellent quality for "metaling" the highways of the southern part of the county.

Throughout the region north of Kentland, the common excuse for the impassible roads was the lack of material with which to improve them. Upon examining the knolls and dividing ridges north of the Iroquois, beds of gravel from *six* to *twelve* feet in thickness were found, near to and south of Morocco, at Kennedy's and A. Doty's. Four miles southeast of Morocco, in Sec. 31, T. 29 N., R. 8 W., there is a gravel hill having an area of ten acres, indicating a good supply, as also on the land of G. W. Carmichael. This gravel is the detritus of the bowlder drift, and of such quality as to offer the best possible material for constructing turnpikes and other good roads.

Other beds exist along the whole course of this ridge, and the supply is sufficient to afford good roads, passable at any season of the year in every part of the county. It seems strange that this bounty of nature, this grand source of comfort has hitherto been so constantly overlooked.

## CLAYS.

Clays, for brick and tile, of good quality, are found in all parts where heavy growths of timber have existed, and in some of the island groves; they invite use by the prudent builder and farmer.

## CEREALS AND GRASSES.

On rolling lands, or those partially ditched, the crops of corn, wheat and oats were excellent, showing heavy and profitable yields. Sorghum is cultivated and does well, while the cultivation of flax-seed could be made profitable.

The black lands, in a state of nature, were covered with a luxuriant growth of wild grass, and when subdued they readily set to tame grasses, including blue grass.

## FRUITS.

The more elevated sandy hills and ridges are well suited to the growth of fruits. Grapevines and the small fruits are especially productive and profitable, and meet a ready market in the city of Chicago.

## GARDEN VEGETABLES.

These grow luxuriantly in the warm, rich soils of this county, with profit to the farmer and joy to the housewife. The remuneration in their cultivation invites the devotion of larger areas to this purpose.

## GARDEN SEEDS.

Several farms in the northern parts are devoted to the raising of garden seeds for the great dealers in Michigan, New England and the Eastern seaboard. The choicest grades of seeds, raised on Indiana soil, are bettered (?) and largely improved (?) by shipment from hence to the great dealers, who *return* them with flashy show-bills, well-engraved envelopes and doubled prices!

The garden seeds produced here are equal if not superior to those raised elsewhere, and return a handsome profit, or 200 to 300 per cent. upon the labor bestowed.



## FISH AND GAME.

The streams of this county are filled with the most delicious of lake fish, while the woods and swamps, in season, are crowded with game. Fishing and hunting stations abound along the Kankakee and adjoining waters, and trips to these regions afford rest, pleasure and healthful exercise to many of our own citizens as well as people from the neighboring cities and States.

## THANKS.

Thanks are due, and hereby returned, to Captain Conner, Dr. B. C. McCain, W. W. Pfrimmer, Master Willie Drake, Geo. G. Jenkins and the citizens generally for hospitality, guidance and useful and advantageous assistance.

## GEOLOGICAL SURVEY OF JASPER COUNTY.

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Jasper county is bounded on the north by Lake and Porter counties, on the east by Pulaski and White, on the south by White and Benton, and on the west by Newton county.

Organized in 1837, it was named in honor of Sergeant Jasper, the gallant defender of Fort Moultrie during the revolution, and then contained 975 square miles. This area was reduced to about 500 square miles by the separate organization of Newton county from its territory, in 1860. It now contains 353,206 acres taxed, of which originally about 50 per cent. was prairie, 10 per cent. good timber land, and 40 per cent. brush and small timber.

Rensselaer, the county seat, is situated on the Iroquois river, a little south of the central part of the county, 106 miles northwest of Indianapolis, and 72 miles southeast of Chicago, on the C. & I. Air Line. This is a thriving and growing town.

The only other town of any size in the county is Remington, situated near the extreme southern part, on the Logansport & Peoria Branch of the P., C. & St. L. R. R.

The Iroquois river rises near the east-central part of the county, in Newton township, within two miles northeast of Rensselaer; flows northwest, northeast, east, southeast, in a lengthened curve, to a point one and a half miles east of Rensselaer, where it is joined by the Pickamink river, and flows in a general west-southwest direction into Newton county, being joined successively by "Big Slough" and Carpenter's creeks from the south, and Curtiss' creek from the north. With its affluents, it drains over three-fourths of the county.

The Kankakee river forms the northern boundary, having a general western trend. The stream is sluggish and tortuous, and is lined with a growth of timber.

The southwestern part of this county is a gently rolling prairie, of black, loamy soil. In the northern and northeastern portions, the soil is sandy, with oak openings and slashy prairies, interspersed with sandy knolls and ridges, and is much in a wild state of nature, scarcely disturbed by the hand of man.

The whole county is underlaid by beds of boulder drift, which vary in depth from twenty feet in the valley of the Iroquois, to nearly two hundred feet at some of the higher ridges.

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### RECENT GEOLOGY.

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The surface of this county is from eighty to one hundred and fifty feet below the tip-top level of the adjacent beds of boulder drift, and presents a nearly level plateau, from whence streams flow east, west, north and south; and, as is general with such water sheds where there is no marked incline in one direction, it is level, and swamps occur.

The phenomenon of the Great Ice age has eroded and removed from the entire area of the county from fifty to two hundred feet of rock, carrying away the finer and softer clays and soluble material, and covering much of the surface with sands.

A narrow extension of rocks, of the Sub-Carboniferous and Carboniferous ages, by way of Remington, reaches up in a north-northeasterly direction, to a point near to and southeast of Rensselaer, and an isolated bed of the conglomerate sandstone here exists. These strata may assist in explaining the presence of the large amounts of sand which prevail. The actual surface has been largely modified by the sifting, sorting processes of floods of water and sluice ways from melting glaciers; and as the ice receded to the north, these sluice ways, being no longer fed or obstructed, left numerous lakes to occupy their ancient channels. As in Newton county, these later lakes are now marked by swamps and ponds. The winds have built up, on their northeast and east shores, ridges of sand and traveling knolls of the same, with gentle slopes facing the direction of the prevailing winds, from southwest, and abrupt banks to the northeast and east. On the C. & I. Air Line R. R., between

Rensselaer and the Kankakee river, some of these ridges and knolls are cut through, giving good opportunities for sectional observation. They are so obscurely laminated as to prove conclusively that they were not, in such cases, deposited by lacustral or fluvial waters, but, on the contrary, were heaped up and shaped by the action of the southwestern winds. Near the center of the county, the line of the ancient ridge which formerly separated the east-west flow of the Kankakee from the Iroquois, will afford good gravel and other material for road making. This invites attention and exploration.

It has been stated in the "Geology of Newton County" (to which reference is here made), that during the term of the east-west trend of the earliest ice flow, and which preceded the north-south flow, the valley of the Iroquois, a short distance south of its present bed, had been excavated to a depth of 150 to 200 feet below its present water level in that county. Although no definite information from deep bores was attainable, the probability is manifest that this ancient channel, now filled so deeply with boulder clays, extends across Jasper county to near its eastern boundary, in a course north,  $80^{\circ}$  east, and when the time comes, as it "may and will," when these large areas are to be improved and made productive, the combined efforts of the two counties, supplemented by the consent of their Illinois neighbors, by opening up a new course for the Iroquois through this old channel, as more fully commented upon in the report on Newton county, will effectually drain an immense area of wet land to a depth of twenty or thirty feet, and enrich citizens of this county and the State of Indiana to the extent of millions of dollars.

The northern part of Jasper and Newton counties may be wonderfully benefited, their productions and the health, wealth and physical vigor of the people increased, by the straightening and deepening of the channel of the Kankakee river, as shown by the late able report of Professor John L. Campbell, Engineer of the Kankakee improvement. The cost of such improvement is insignificant compared with the immense benefits to be derived. After such an outlet is opened, the crop of a single year over this immense area would doubly repay the whole expense, while in the near future a teeming population, with healthful homes, school houses and churches—the muni-

ments of freedom and the Republic—will rise like magic from the reedy swamps, now inhabited by the water fowl and fish. In the longer future these dreary stretches and impassable fens will not only reward their owners with produce and wealth, but will annually repay the State and municipal authorities, at the ordinary rate of taxation, the entire cost.

Broad acres and wealth alone can not bring the full enjoyments of life and labor. Wet lands, impassible roads, are followed by weakened vitality, diminished energy; the contrary produce health, and physical and mental vigor. These again are followed by enterprise and morality. Hence every rule of reason invites energetic and successful action looking toward the drainage of these lands.

### PALEOZOIC GEOLOGY.

The rocky exposures of the county show the presence of the Sub-Carboniferous, Devonian and Silurian ages. Some fragments of black slate, and even coal, are met with in wells through the boulder clay, suggesting that once outliers of the Carboniferous age extended over this region some distance to the north and northeast of Rensselaer, since principally removed by erosion and glacial action.

A connected section, collected from isolated localities, is given:

#### *Connected Section of Jasper County.*

Soil and loam.....	2 to	5 ft.
Boulder drift.....	20 to	200
Conglomerate sand rock.....	0 to	40
Keokuk limestone and shale.....	0 to	10
“Waverly,” or Knob sandstone.....	0 to	15
Louisville-Delphi black slate (Genessee shale)....	0 to	62
Devonian limestone.....	25 to	2
Silurian limestone (exposed).....		8
Silurian limestone (porous with cavities filled with petroleum and gas—in bores) .....		855
Total.....		1,197 ft.

The highest rocks of the county occur at Pierce's quarry, on J. C. Van Rensselaer's farm, about three and a half miles south-east of Rensselaer—section 33, township 29 north, range 6 west. This is a coarse grit, the conglomerate sandstone of the coal measures. This bed shows a depth in sight of eight feet, and is an excellent quality of sandstone for foundations, piers and heavy masonry, and is to a considerable degree fire as well as weather proof. Fossils—mostly indistinct—of *Ferns*, *Calamites*, *Sternbergii*, *Fucoids*, etc., were found here in considerable abundance. The top of the bed is planished and striated by glacial action, and shows clearly the erosive force which took place over all this section during the Great Ice age. Striæ show the direction to have been from north to south from 12° to 15° east.

The rock exhibits the phenomenon so common in the conglomerate sandstone—false bedding, with faces sloping to the south-southwest, indicating the great depth of the coal measure sea, and the source of tidal waves in that direction. The coarse grains of sand and worn specimens of plants, indicate the violence of the currents and waves that beat upon this ancient shore line.

*Section at Alter's Quarry, Northwest of Remington.*

Chester, or conglomerate, sandstone.....	6 ft.
Limestone with partings, buff colored, Keokuk group...	8
Total.....	14 ft.

*List of Fossils found at Alter's Quarry.*

RADIATA.

<i>Zaphrentis dalii</i> .....	Edwards & Haime.
<i>Lophophyllum proliferum</i> .....	Edwards & Haime.

ECHINODERMATA.

<i>Actinocrinus lowei</i> .....	Hall.
<i>Dichocrinus simplex</i> .....	Shumard.
<i>Platycrinus bonoensis</i> .....	White.

## BRACHIOPODA.

<i>Streptorhynchus crenistriatus</i> .....	Phillips.
<i>Rhynchonella mutata</i> .....	Hall.
<i>Strophomena rhomboidalis</i> .....	Wahlenberg.
<i>Chonetes fischeri</i> .....	Norwood & Pratten.
<i>Chonetes planumbonum</i> .....	Meek & Worthen.
<i>Spirifer rostellatus</i> .....	Hall.
<i>Spirifer keokuk</i> .....	Hall.
<i>Spirifer</i> .....Sp. ?.....	
<i>Athyris lamellosa</i> .....	Leveille.
<i>Athyris</i> .....Sp. ?.....	
<i>Orthis michelinia</i> .....	Hall.

At Jordan's Grove, on Carpenter's creek, occurs an exposure of irregularly bedded argillaceous sandstone, which belongs, stratigraphically, to the lower division of the "Waverly," or Knob sandstone. It was formerly quarried for local use in foundations.

A short distance further north, still on Carpenter's creek, is a bluff exposing the Genessee shale, or slate, to a depth of about twenty-three feet. This underlies the "Waverly" Knob stone, and has probably been eroded by the bowlder drift at least thirty feet. It is slightly glazed with petroleum, and some years since a bore was put down for oil, the slate being found to extend forty feet below the surface, giving a total depth of sixty-three feet.

A thin bed of limestone at Allen's quarry, about four miles west, on a branch of Carpenter's creek, gave a good quality of stone, which seems to weather well in several houses and barns which have been built of it, but no fossils are present to determine its horizon.

At Rensselaer the Iroquois flows over a bed of cherty limestone, forming through the town a series of rapids for several hundred yards. At the town the rock is unfit for burning into lime, but is used considerably for road-making. Lower down it is purer, and considerable lime is burned for local use.

A short distance above, at the dam, thin beds of limestone of the Devonian are seen in the low banks, and Upper Silurian in the bed of the river at low stages of water.

These beds are the only rocky exposures to be seen along the Iroquois in this county. The point at the dam seems to be an anticlinal axis from which the strata dip in a northeast and southeast direction.

*List of Fossils Found at Rensselaer, near the Old Mill Dam South Side of the Iroquois River.*

RADIATA.

<i>Favosites epidermatus</i> .....	Rominger.
<i>Favosites emmonsii</i> .....	Rominger.
<i>Favosites limitaris</i> .....	Rominger.
<i>Favosites hemisphericus</i> .....	Yandell & Shumard.
<i>Favosites tuberosus</i> .....	Rominger.
<i>Cyathophyllum rugosum</i> .....	Edwards & Haime.
<i>Aceroularia davidsoni</i> .....	Hall.
<i>Cystiphyllum vesiculosum</i> .....	Edwards & Haime.
<i>Cystiphyllum sulcatum</i> .....	Billings.
<i>Syringopora perelegans</i> .....	Billings.
<i>Syringopora tubiporoides</i> .....	Yandell & Shumard.
<i>Stromatopora pustulifera</i> .....	Winchell.
<i>Stromatopora nodulosa</i> .....	Nicholson.

BRACHIOPODA.

<i>Atrypa reticularis</i> .....	Linneus.
<i>Pentamerus</i> ..... <i>Sp.?</i> .....	

GASTEROPODA.

<i>Euomphalus deccwi</i> .....	Billings.
<i>Loxonema teres</i> .....	Hall.

CEPHALOPODA.

<i>Orthoceras</i> ..... <i>Sp.?</i> .....	(In bed of river.)
<i>Gomphoceras</i> ..... <i>Sp.?</i> .....	(In bed of river.)

A few hundred feet below the dam, opposite the residence of Mr. Scott, is an exposure 50x5 feet, showing very distinctly the powerful action of the glaciers, the whole surface being planished and striated in a remarkable way, the lines of the striae



giving a direction from north to nearly south. The markings evidently extend for some distance under the south bank of the stream.

Just below the mill, in town, on the opposite side of the river, and at a level at least twenty feet lower than this, similar distinct markings are to be seen over a considerable area.

At Porter's, one and a quarter miles lower down, where good lime is burned from quarries in the bed of the river, and on the banks, the rocks of the Silurian age are exposed, as will be seen from the following:

*List of Fossils found at Porter's Quarry, one and one-fourth miles West of Rensselaer, on the South Side of the Iroquois River.*

### NIAGARA GROUP, UPPER SILURIAN.

#### RADIATA.

<i>Lyellia americana</i> .....	Edwards & Haime.
<i>Halysites catenulatus</i> .....	Linneus.
<i>Favosites niagarensis</i> .....	Hall.
<i>Favosites favosus</i> .....	Hall.
<i>Favosites forbesi</i> (var. <i>occidentalis</i> ).....	Hall.
<i>Stromatopora concentrica</i> .....	Owen.

#### BRACHIOPODA.

<i>Pentamerus galeatus</i> .....	Dalman.
<i>Pentamerus nysiuis</i> .....	Hall.
<i>Pentamerus oblongus</i> .....	Sowerby.
<i>Pentamerus knighti</i> .....	Sowerby.

#### GASTEROPODA.

<i>Platystoma niagarensis</i> .....	Hall.
<i>Strophostylus cyclostomus</i> .....	Hall.

#### CEPHALOPODA.

<i>Orthoceras crehescens</i> .....	Hall.
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#### CRUSTACEA.

<i>Calymene niagarensis</i> .....	Hall.
<i>Illænus ioxus</i> .....	Hall.

The remains of the ancient giant animals of Indiana have been found in this county, while the bones of the buffalo, beaver and bear are common; the remains, partially decomposed, of the mastodon were found at one place, and at another those of a mammoth (or elephant). These, in gathering the tall grasses from the swamps, had mired and left their bones in a preserving bed of peat.

The remains of the Mound Building race are not plentiful in this county. Spears, arrow-heads, axes and scrapers have been found, some of the former made of a glossy chert, of the peculiar form seen only in Tennessee, the latter of highly polished stone. About four miles northeast of the county seat, on the east side of the river, is a mound, the only authentic relic of the race, about ten feet high, forty feet in diameter and it contained ashes, bones and shells.

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## ECONOMIC GEOLOGY.

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### SOIL.

It will be seen from the foregoing that Jasper county contains a considerable body of highly productive lands. All the cereals and the grasses grow well in the loamy soil in the southwestern parts, and in other localities where drainage exists. The wild grasses of this county feed herds of cattle, and extensive grazing is carried on with great success.

### FRUITS.

Apples, peaches, pears, and all of the staple fruits succeed well in localities protected by the presence of adjacent ponds and lakelets, and the porous nature of the sandy soil. Small fruits, plums, grapes, strawberries, blackberries, raspberries, and cranberries grow in great profusion, and are, so to speak, to the "manor" born, and afford berries of delicious flavor. This is the native home of the cranberry; and many of the ponds, swamps and water thoroughfares are perfectly adapted to the cultivation of this delicious fruit. The nature of the

plant requires that at certain seasons of the year the plantation beds must be overflowed, and at a late season the water must be drawn off by sluiceways. After the wild vegetation has been subdued, adjoining sand ridges and knolls furnish material and facilities for cheaply bedding and covering the roots of the young plants with sand free from foreign material.

Experiments in Laporte and other counties show that the cranberry, properly cultivated, may be grown successfully with large profit. It has been noted in the former Geological Report of 1873 that large plats of cranberries grow wild in Elkhart, Lagrange, Laporte and Warren counties. In the latter county the "Cranberry Pond" (page 229, Report of 1873) contained two classes of plants and berries—the "long-vine," bearing oblong, and the "short-vine," bearing sphere-shaped berries. In this locality the maximum crop of a favorable year, without any care or attention, would yield not less than 70 bushels to the acre, ranging thence, in a dry season, down to 10 bushels per acre. Good crops follow a "wet" June, or the reverse—clearly indicating the right season for flooding the beds when under cultivation. Such grounds should, with proper care, yield a profit of from \$50 to \$300 per acre, and give a greater income than can be obtained by any other production.

#### CLAY.

Good clay for brick and tile making is common throughout the county, as indicated by the substantial brick buildings at Rensselaer and other towns. Near the county seat a fine grade of patent pressed brick and tile are manufactured in large quantities.

#### BUILDING STONE AND LIME.

The conglomerate sandstone at Van Rensselaer's quarry is admirably adapted for foundation and heavy masonry; while the underlying limestones in many parts of the county furnish a good quality of material for building purposes and for burning into lime.

#### ROAD MATERIAL.

The cherty limestone at Rensselaer, affords an excellent quality of rock for road beds, while gravel of the best road-

making quality, is to be found along the ridges and mounds dividing the courses of the ancient Kankakee and Iroquois rivers. A reliable bed of gravel of considerable extent, lies on Thompson's farm, section 16, township 29, range 6, and another bed, though smaller in size, exists on the opposite side of the creek. These gravels with the abundant limestones about the county seat afford ample material for good roads.

#### IRON.

In the northern part of the county extensive deposits of bog-iron ore exist. The area of deposit, as estimated by Mr. S. P. Thompson, some time since, in townships 30, 31 and 32 north, ranges 5, 6 and 7 west, extended over about 5,700 acres. The beds are, as a rule, from one to two and a half feet below the surface, and from five to six inches thick, while in some places they were reported to be two to two and a half feet in thickness. With better shipping facilities, the digging of this ore might in the future become profitable.

#### MEDICINAL SPRINGS.

Near Rensselaer a number of mineral springs exist, the waters of which prove to be highly medicinal. Being sulphuretted, they are of especial value in a malarial climate. An artesian well bored close to the town to a depth of over eight hundred feet, discharges a large volume of highly sulphuretted water, which has already gained a more than local reputation for its health-giving qualities.

#### PETROLEUM.

Oil is present in the limestones about Rensselaer, and most of the rocks in that vicinity contain more or less bitumen (desiccated petroleum).

The fluid, however, is so diffused and so limited in quantity that it can be of no possible economic value. The artesian well at Rensselaer was sunk for the purpose of "striking oil," but the medicinal water which it yields is of more value than all the petroleum which will be found throughout the county.

## FISH AND GAME.

Fish and game are very plentiful along the streams, and Jasper county is visited by large numbers of sportsmen yearly, who always go away well repaid for their time and expense. The fish are of the finest lake, as well as river varieties, while, in season, wild duck, geese, brant and other game birds swarm in the ponds and marshes and along the streams.

## THANKS.

Thanks are hereby tendered to Dr. Loughridge for assistance and specimens; to Prof. W. De M. Hooper for donations to the Museum, and to Hon. R. S. Dwiggin, Wash. L. Grant, and the citizens generally for assistance and courtesies.

## TABLE OF ALTITUDES.

### JASPER AND NEWTON COUNTIES.

#### *Line of Logansport, Peoria & Warsaw Railroad.*

	<i>Feet Above Ocean.</i>
Indianapolis Union Depot.....	721.20
State Line between Indiana and Illinois.....	680.00
Kentland Station.....	684.00
Goodland Station.....	721.00
Remington Station.....	735.00
Wolcott Station.....	718.00
Reynolds .....	695.00
Surface Water of Tippecanoe.....	605.00
Monticello Station .....	675.00
Logansport Station.....	596.00

#### *Line of Wabash & Erie Canal.*

Toledo, average level Lake Erie.....	573.00
Fort Wayne, summit level.....	767.00
Wabash, Court House square.....	730.00
Peru, Court House square.....	657.00
Mouth of Eel River, Logansport.....	583.00
Low Water Wabash River, at Delphi, below Pittsburgh Dam .....	526.00
Low Water Wabash River, at Lafayette.....	506.00
Low Water Wabash River, at Terre Haute.....	451.00
Low Water Wabash River, at Evansville.....	326.00

*Water Level Line of Kankakee River—Prof. J. L. Campbell's  
Kankakee Survey.*

	<i>Feet Above Ocean.</i>
South Bend, near head of river.....	726.00
Mouth of Mill Creek, crossing of P., Ft. W. & C. R. R.	682.10
English Lake, outlet.....	667.10
Dunn's Bridge, Jasper county.....	663.70
San Pierre, Pulaski county.....	705.00
"Grand Junction," 1½ miles east of Raum's Bridge, Jasper county.....	660.50
Hebron, Porter county.....	676.00
Rose Lawn, C. & I. Air Line R. R., Newton county.....	675.00
Bridge of C. & I. Air Line R. R., Newton county.....	635.70
Blue Grass Bridge, Newton county.....	632.20
Lowell, Lake county.....	665.00
State Line, Indiana and Illinois.....	624.30
Momence, Ill.....	613.50

*Line of Louisville, New Albany & Chicago Railroad.*

Track at Lafayette.....	553.00
Water surface Wabash river at L., N. A. & C. Ry. bridge.....	511.00
Track at Chalmers.....	710.00
Water surface, Kankakee river.....	674.00
Track at Westville.....	789.00
Track at Michigan City.....	601.00
Surface of Lake Michigan.....	585.00

# Report of a Geological and Topographical Survey of Marion County, Indiana,

Made Under the Direction of Prof. JOHN COLLETT, Chief of the Department  
of Geology and Natural History.

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By RYLAND T. BROWN, A. M., M. D.,

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## GEOGRAPHICAL AND HISTORICAL NOTES.

Marion is the central county of Indiana. It is bounded on the north by Hamilton and Boone counties, on the east by Shelby and Hancock, on the south by Johnson and Morgan, and on the west by Hendricks. It comprises an area of 400 square miles. The county was organized by an act of the Legislature approved the last day of the year 1821, and the territory now comprising the counties of Hamilton, Boone, Madison and Hancock was attached to it for judicial purposes. On the first Monday in April, 1822, an election for county officers was held, at which 336 votes were cast. At the first meeting of the County Commissioners an appropriation of \$8,000 was made to erect a court house of brick, at least fifty feet square, the use of which was tendered to the State for the sessions of the Supreme Court and Legislature, for the period of fifty years, or until a State House should be built.

The territory of Marion county was originally the property of the Delaware tribe of Indians, and was ceded to the United States by the treaty of St. Mary's in 1818; with the stipulation that the land should not be sold before 1820. In that year the government surveys were made, and in the month of October the land was offered for sale. By the act of Congress admit-



ting Indiana into the Union, approved April 19th, 1816, four sections of unsold land were donated to the State for a permanent capital. The Legislature of the State at its session in 1820, appointed ten commissioners to locate this land—the future Capital City of the State. Five of these commissioners accepted the appointment, and after a careful examination of several points, they located the donation on White river at the mouth of Fall Creek. The selection was confirmed by the Legislature in January, 1821, and the prospective city was named

#### INDIANAPOLIS,

(A compound of English and Greek—Indiana, English for the State, and Polis, Greek for city), at the suggestion of Judge Jeremiah Sullivan, of Jefferson county. Early in the spring of 1820, George Pogue, John McCormick and his brother, James McCormick, built and inhabited cabins on what was afterwards selected as the government donation, and prior to the location of the capital in June of that year, several other pioneers had joined them. Christopher Harrison, James Jones and Samuel P. Booker were appointed Commissioners to make a plat of the town and survey the streets and lots. These Commissioners intrusted the work to Judge Harrison, who employed Alexander Ralston and Elias P. Fordman surveyors. Ralston has the credit of drafting the original plat, and to him Indianapolis is indebted for her wide streets and convenient diagonal avenues. A square mile was surveyed near the center of the donation, and this was divided into four equal parts by Meridian street running north and south, and Market street east and west. At the intersection of these, a circle 400 feet in diameter was laid off, designed for the Governor's residence. From this circle broad avenues extended to the four corners of the square mile, and streets running towards the cardinal points divided the plat into squares 420 feet on each side. That portion of the original donation lying outside of this plat was divided into large outlots intended for suburban residences. The first sale of lots took place on the 10th of October, 1821, and was continued from day to day till 314 lots were disposed of, realizing the sum of \$35,596.

On the 7th of March, 1822, a postoffice was established at the new capital and an eastern and southern mail route was opened. On the 28th day of January, 1822, George Smith and Nathaniel Bolton issued the first number of the "Indianapolis Gazette," and a year later Harvey Gregg and Douglass McGuire commenced the publication of the "Western Censor." In November, 1824, the archives of the State were removed from Corydon to Indianapolis, and it became the permanent capital of the State. From that date but few inland cities have advanced as rapidly in population, in wealth and in commercial and manufacturing importance. This has been generally attributed to its geographical situation in the middle of one of the most fertile plains of the great West, enjoying a climate equally removed from the tropical summers of the Southern States and from the arctic winters of the Northern. But it is doubtful if these conditions have contributed more to its prosperity than have its remarkable topographical and geological surroundings, which we will proceed to notice.

#### TOPOGRAPHY.

Marion county may be regarded as part of a great plain, yet there is but a very small part of it that is actually level. The county is divided by the broad valley of White river. This valley, in its general direction, has a bearing of about 20 degrees east of north and west of south, and varies from one to four or more miles in width. On its west side it presents, in the greater part of its course, an abrupt bluff, ranging from 50 to 200 feet high. On the east side the descent from the elevated table land to the White river valley is generally a long, gentle slope. The average elevation of this plain above low water in the river is about 175 feet, or 860 feet above tide water. Occasionally, however, the elevation above the river exceeds 200 feet. These slight diversities of elevation give a pleasing variety to the landscape, where the forest is cleared away, that was not apparent in its primitive state. The drainage of this plain is effected on the east side of White river by Fall creek and its tributaries, Pogue's Run, Pleasant Run, Lick creek and Buck creek, and on the west side of the river by Williams creek, Eagle creek and its tributaries, and by Dollar-

hide creek. A water shed, dividing the tributaries of the east and west White rivers, enters the county from the south, about two miles west from the southeast corner, and bearing nearly due north for a distance of twelve miles, where it makes a detour to the east and passes out of the county. Water sheds in this region are not high ridges, as in most countries. On the contrary, these divides are generally marshy, and in time of heavy rains, are often flooded with water. It is here that the streams have their sources, and, subdividing, they often degenerate into sloughs, and sometimes into broad swamps. These, however, being on the highest lands, are always susceptible of drainage, when they become a superior quality of farming lands.

White Lick, a large stream that has its rise in Boone county, and flowing southwardly, nearly parallel with the western line of Marion county, empties into White river in Morgan county. This accounts for the few streams flowing into White river from the west. The valley of White river is divided into alluvium, or bottom land proper, and the terrace or second bottom. In that portion of the valley that lies north of the mouth of Eagle creek it consists chiefly of second bottom, while the first bottom largely predominates in the southern portion of the valley. Much of this is subject to overflow in times of freshets. While these lands are exceedingly fertile and easy of cultivation, yet a crop is never safe on them.

To remedy this defect, several miles of levee have been made, but with only partial success. There is a geological reason which may conduce somewhat to this overflow, (which we will notice in its proper place) but the immediate cause is the tortuous course of the stream. From Indianapolis to the point where the river crosses the county line is nine miles, on a direct line; but following the meanders of the stream the distance is about sixteen miles. This not only diminishes the fall, per mile, but the water being compelled to move in curves and reversed curves, wastes its momentum, the current becomes sluggish, the water accumulates and overflows the low banks and inundates large districts of farm lands. If a new channel could be formed, as nearly on a straight line as practicable, the current would be rapid, and as the formation is chiefly sand, it would soon cut itself deep enough to secure most of the ground

against overflow. This would cost less than to levee the present stream in its crooked course, but it would require a concert of action among the land owners; and worse than that, it would divide farms, leaving part on one side and the remainder on the other. Unfortunately, White river was considered a navigable stream, at which the original surveys terminated on each side, and the fractions were numbered accordingly. To change the bed of the stream would confuse these numbers, and might unsettle land titles; and yet it appears to be the only practical method of controlling the river in times of freshets.

The glacial action which left a heavy deposit of transported material over the whole surface of the county, has at the same time plowed out several broad valleys of erosion which appear to be tributary to the White River Valley. The best marked of these, come down from the northeast between Fall Creek and White River. It is about a mile wide at its lower end and narrows to the northeast for six or seven miles, disappearing near the northern line of the county. The erosion has cut away the surface clay and, in places, filled the excavation with gravel and coarse sand. On the west side of the river a remarkable glacial valley begins near the northwest corner of Morgan county and proceeds eastward, north  $20^{\circ}$ , a few miles south of the north line of that county, crossing White Lick a mile north of Mooresville, and, entering Marion county, it passes between West Newton and Valley Mills, joining White River Valley near the mouth of Dollarhide creek.

Another glacial valley, nearly a mile wide, extends from White river at a point a little north of Glen's Valley, bearing northeast for a distance of about five miles. The margins of this valley are very well defined on each side, being composed chiefly of gravel terraces. South of this, lying chiefly in Johnson county, is another broad and deep valley of erosion. Between these two a narrow ridge rises to the height of one hundred feet above the level of the river. This has long been known by the local name of Poplar Hill. It is composed of sand and gravel resting on a solid basis of blue clay.

## GEOLOGY.

Marion county rests on three distinct geological members, two of them belonging to the Devonian formation and one to the Carboniferous; though neither of these show themselves conspicuously on the surface. Over these lies a deposit of drift or transported material, from fifty to one hundred and fifty feet thick. This forms the surface of the country and moulds its general configuration. However, the underlying rock exerts some influence on the face of the county, notwithstanding the depth of its drift covering. This is most apparent along the line where the Knob sandstone overlaps the Genessee shale. The line of strike dividing the geological members traverses the county on a line from the south, bearing about  $30^{\circ}$  west of north. This line, as it divides the Carboniferous limestone from the Genessee shale (black slate) passes between this city and the Hospital for the Insane. Borings in the city reach the limestone at a depth of from sixty to one hundred feet, it being the first rock, in place, encountered; but at the Hospital forty feet of shale was passed through before reaching the limestone. This gives the eastern portion of the county as resting on the Carboniferous limestone, and the western on the Delphi black slate, technically known as the Genessee shale. Under a few square miles in the southwestern corner of the county the Knob sandstone (Carboniferous) will be found covering the slate. A short distance north of the Johnson county line was observed, after a freshet, large pieces of slate thrown out on a sand-bar, indicating that the river had laid bare that rock at some point near by. This gives its characteristic level to the bed of White River in the lower half of its course through the county. But a short distance west of the western line of the county, streams tributary to White Lick lay bare the lower members of the Knob sandstone.

There is, therefore, but little risk in assuming that Sections 9, 16, 21 and 22, in Town 14, Range 2, are underlaid with this sandstone. There are indications both on Pogues' run and Pleasant run that the limestone is very near the bed of the stream, but it is not probable that stone quarries can ever be profitably worked in this county. The geological interest here

lies chiefly in the heavy deposits of transported material that so completely conceal the stratified rocks beneath.

These drift fields present problems to the geologist, much more difficult of solution than are those of the older rocks; but these great plains of the West will furnish the means of solving these problems, if they are ever to be solved. Elsewhere, these glacial agencies have cut down the hills and piled the eroded material in promiscuous masses in the valleys. The drift, therefore, is local, both in its origin and in its deposition; but the drift that covers our great western plain is foreign in its character and general in its deposition. Moreover, it is not a *promiscuous* deposit of clay, sand, water-worn pebbles and boulders, as the eastern geologists describe their glacial drift to be. True, all these are found, but not without order of arrangement. Indeed, the drift of Marion county, as we have studied it, has nearly as much regularity and order as we generally find in the stratified rocks; and this is but a sample of the deposit that is spread over the northern sections of Ohio, Indiana and Illinois.

At the base of this formation we almost invariably find a heavy member of a very compact, lead colored clay, with but few boulders, and these invariably composed of quartzite rocks, of highly metamorphosed sandstones, or of trap rocks. There may occur, occasionally, in this member, thin deposits of very fine gray or yellow sand, but these are not uniform. Between this clay and the underlying rock there is generally interposed a bed of coarse gravel or small siliceous boulders, from three to six feet thick. In a few instances we have found this bed of gravel wanting—the clay resting firmly on the bed-rock. But this is exceptional and rarely occurs. This clay, in Marion county, ranges from twenty feet to more than a hundred feet thick, and, with the exceptions named, is very uniform in its character throughout. Chemically, it is an alumina silicate in a very fine state of division, and mechanically mixed, is an exceedingly fine sand which, under the microscope, appears to be fragments of nearly transparent quartz. It owes its color to a proto-sulphide of iron (*ferrous sulphide*). A careful analysis shows, also, a small per cent. of lime and potassa, and a trace of phosphoric acid.

Above this is generally found a few feet of coarse sand or

fine gravel, and resting on this lies twenty or thirty feet of a true glacial drift, having the promiscuous character of the glacial drift described by the eastern writers on this subject. In and on this we have large bowlders of granite, gneiss and trap rocks, which are not found *in situ* nearer than the shore of Lake Superior, from which region they have evidently been transported, as numerous scratches and grooves in exposed beds of rock over which these travelers have passed in their journey fully attest. In this same upper drift occur the gravel terraces that opportunely offer us the material for the best of roads, where no other material can be found. But the mass of this upper bed is a yellow or orange-colored clay, with quite a large mixture of sand and a sufficient quantity of lime to render the water that percolates through it hard. The number and size of the bowlders which lie on and near the surface in many localities is amazing, considering the distance of their transportation. On Section 6, in Township 15, Range 3, we measured a boulder of granite, very closely resembling the Quincy, the dimensions of which were nine feet eight inches long, five feet wide, and four feet of it was above ground; how much below, we do not know.

A boulder of the same character, and nearly of the same dimensions, lies near the northwest corner of section 15, in township 16, range 4. In a few localities in this county these bowlders are scattered so thickly as to interfere with cultivation. They may, however, be readily broken up by fire, or blasted into convenient stones for cellar walls, house foundations, etc. In the central and northern portions of the county, the bowlders are almost invariably granitic in their character, but along the southern border they are generally gneiss or trap rock.

The gravel terraces are generally found in a succession of mound-like elevations, rising from ten to fifty feet above the level of the surrounding plain, and are commonly found resting on a compact clay. They are frequently arranged in lines, bearing east, a little north, and west, a few degrees south. North of these gravel mounds we generally find a considerable space of level, and often swampy lands, indicating the position of a mass of ice, under which a torrent of water had rushed with great force, excavating the clay below, piling up the

heavier\* gravel and sand, and carrying the lighter clay and finer sand to be distributed over the country. When the ice disappeared, the excavation would be a miniature lake, to be ultimately filled up with the lighter and finer material borne from other terraces forming still further north.

The terrace formations, or "second bottoms," bordering the river on one side or the other, almost everywhere, have nearly the same character and history as the gravel beds of the uplands. They consist of deposits of gravel and coarse sand, resting on the lower blue clay, into which the river has cut its present channel. Formerly we considered these plains, frequently three or four miles wide, as lake-like expansions of the stream which had been silted up by its sediment; but an inspection of the material deposited shows that the water from which the deposit was made, was no quiet lake, but a current sufficiently strong to bear onward all lighter material, leaving only the heavier gravel and sand behind.

But the fact that these several deposits, which can be clearly traced to the last act of the great ice drama, all rest on the lower blue clay, clearly indicates the pre-existence of this deposit. Moreover, the specific character of this lower member of our drift formation points to the conditions under which it was deposited, as widely different from the rush and tumult of water consequent on a dissolving glacier, and yet it bears the unmistakable marks of deposition from water. The material is, most of it, exceedingly fine and could have been deposited only from very quiet waters, and its compactness and solidity attest the pressure of deep waters. That the glacial action, which has left its marks on the whole surface of our country, took place subsequent to this deposit is indicated by the fact that the small lakes of northern Indiana are excavations in this lower blue clay, made by undermining currents, beneath a dissolving glacier. Indeed, Lake Michigan, at its southern extremity, rests on this clay and is excavated into it, to an unknown depth. Another fact in relation to this lower drift member, has its significance. At the bottom of this clay is frequently found the remains of a cone-bearing forest, probably cypress or hemlock. In this county, several wells that have been dug to the bottom of this clay, have exposed logs, from ten to fifteen inches in diameter, in a good state of preserva-



vation. These are not broken nor crushed as they would have been under the advancing march of a mountain of ice.

The problem of this lower blue clay is one that remains yet to be solved. Indeed, its peculiar character and relations have not been observed and studied, as yet, with sufficient care to furnish reliable data for its solution. Moreover, the problem is one involving many and peculiar difficulties, chiefly owing to the absence of fossils of any description except the remains of an ancient forest, above alluded to. This is not the place, nor have we the time to discuss abstract scientific theories, but we may be allowed to hint that if the Age of Ice was preceded by an upheaval elevating the ground about the Arctic circle above the line of perpetual congelation, it would of necessity involve a corresponding depression south of that upheaval, thus creating a great fresh-water inland sea. The upheaval north and the depression here, though it may have consumed years in its completion, would have caused torrents of water, loaded with sediment, to rush in and fill up the constantly increasing depression. This sediment, as the waters became quiet, would be slowly precipitated. The evidence that these waters were originally charged with sulphurous gases from volcanic agencies, is preserved in the sulphur now combined with iron, giving color to the clay. This will account for the absence of life in this inland sea till the sediment was entirely deposited; after that the increasing cold would seal it over with an impervious crust of ice which would cut off access to the air and forbid the existence of life. At the close of the Ice age, when these conditions were reversed by the sinking of the northern elevation and the rising of the bed of the fresh-water sea, as well as by the dissolving of the mountains of ice, torrents of water would rush over the southern plains to the Gulf of Mexico, leaving the marks of denudation on the hills of Kentucky, Tennessee and Alabama, that are now so plainly visible, and furnishing much of the material that now forms the delta of the Mississippi.

But apart from theories and speculations, this clay serves several practical purposes which are of great economical value. When exposed to the atmospheric agencies for a few years it undergoes important chemical changes which make it the basis of a very productive soil. The action of frost breaks down and

destroys its adhesive quality, and it becomes a fine mass of crumbling, porous earth. The action of the oxygen of the air converts the sulphur into an acid, which, seizing on the potash and lime present, converts them into slowly soluble salts of these bases which furnish important mineral elements of fertility for years of cropping, needing only organic matter to make it available for immediate use. The fineness of the material makes it an excellent absorbent, and as such it might be profitably used in composting manures, retaining the ammonia as a sulphate.

But the practical importance of this bed of clay is that it acts as a filter, securing an inexhaustible supply of very pure water in the gravel and bowlders beneath it. In a country as level as Marion county is, and as productive of vegetation, the surface water must become charged with organic matter, which the porous upper beds of soil, clay and sand but imperfectly arrest, so that the water furnished by superficial springs and shallow wells, is seldom so free from organic matter as to make it fit for domestic uses. These soluble organic impurities are always increased in the vicinity of inhabited houses, and of stables and barns in use. They are not only increased in quantity, but intensified in their objectionable qualities by a large increase of animal matter, from unavoidable accumulation of excrementitious substances. The surface water, from rains and melting snows, is rapidly absorbed by the porous loam, and the facility with which it reaches a tile drain, three or four feet from the surface, suggests the possibility that it may contaminate the water of a well even twenty feet deep; and an analysis too often confirms this unpleasant suspicion. If this be true of country places, where farm houses are far apart, how shall we escape the contamination of our superficial wells in a city situated as Indianapolis is? As yet our population is not sufficiently dense to greatly impair the health of the city from this cause; but the supply of potable water is the great sanitary problem, not only of this and other cities, but of all the country located on this loose, porous, drift soil. Fortunately, the solution of this problem is found in the reservoir of filtered water held in the bed of gravel and bowlders lying below this perfect filter of blue clay. We may not know how that clay came

there, but we can know what beneficent purpose it serves. The water from this source is practically free from organic matter, but always contains iron in sufficient quantity to be perceptible by the taste, and to tinge vessels red that are used to contain it. This is a characteristic mark by which this lower water can be distinguished wherever found. The general dip of the underlying rock of this county being westward, and the blue clay being impervious, except by slow filtration, it follows that the lower water will rise to the level of its outlet, wherever that may be. The result of this is, that where natural fissures occur in the clay the water rises, and often overflows in natural artesian wells, that are known by the characteristic tinge which the water, in time, gives to everything it comes in contact with. These springs are constant in the quantity, quality and temperature of the water discharged. There are a number of these springs in Marion county, several of which are quite noted. As specimens of this class, we may name the Minnewa Spring, one and one-half miles northeast of the village of Lawrence, and the Fair-ground Spring, on the farm of John Brown, half a mile northwest of that village. These rise perpendicularly through the blue clay to the surface, where it is one hundred and eighty feet above the water in White river, at Indianapolis. A noted spring of this character breaks through the blue clay, at the foot of the river hill, on the farm of the late Demas McFarland, about a mile southwest of Maywood. But, perhaps, the largest of these springs in the county is on the farm of Fielding Beeler, on the Vincennes railroad, two miles from this city. It forms a wet prairie, or marsh, of several acres, from which, by ditching, a large stream of water is made to flow. These are generally, but improperly, known as Sulphur Springs.

This lower fountain has been reached by tube wells in a number of places in this city, and its immediate vicinity, which not only tests the quality of this water and its abundant supply, but gives us an opportunity to study the arrangement and relation of the different members of the drift formation in this county. We subjoin a few sections obtained from these borings:

1.—*At Butler University, Irvington.*

Above Indianapolis 119 feet.

Yellow clay and loam.....	18 ft.
Blue clay.....	18
Quicksand (water).....	4
Blue clay.....	60
Coarse gravel (water).....	8
Total.....	<u>108 ft.</u>

Here the water rose to the quicksand, forty feet from the surface.

2.—*On the Carter Farm.*

Section 14, range 3, township 16.

Loam and yellow clay, with occasional boulders.....	20 ft.
Sand (water).....	2
Blue clay, with gravel below (water).....	60
Total.....	<u>82 ft.</u>

Water rises within twenty feet of the surface. This well is about ninety feet above low water in White river, opposite this point.

3.—*Well at Brightwood.*

Eighty-three feet above Union Depot.

Loam and yellow clay.....	22 ft.
Sand (water).....	2
Blue clay.....	36
Fine sand (water).....	8
Blue clay.....	40
Coarse gravel.....	4
Total.....	<u>107 ft.</u>

Water rising within twenty-five feet of surface.

4.—*Well in Garfield Park, City.*

Loam and yellow clay, with occasional bowlders.....	18 ft.
Sand (water).....	2
Blue clay.....	60
Gravel (water).....	2
Total.....	82 ft.

Water rises within eight feet of surface.

5.—*Well in University Park, City.*

Loam.....	3 ft.
Gravel to water.....	17
Gravel below water.....	20
Blue clay.....	25
Coarse gravel.....	2
Total.....	67 ft.

Water rising within twenty feet of surface.

6.—*Well at the Junction of St. Clair and Alabama Streets.*

Loam and clay.....	4 ft.
Gravel to water.....	16
Gravel below water.....	18
Blue clay.....	19
Quicksand (water).....	4
Blue clay.....	14
Coarse gravel.....	2
Total.....	77 ft.

Water rising within twenty-four feet of surface.

7.—*Well in Circle Park, City.*

Gravel and sand (upper water).....	61 ft.
Blue clay.....	9
Flint conglomerate.....	2
Coarse gravel (lower water).....	16
Total.....	88 ft.

NOTE.—This "Flint conglomerate" consisted of Siliceous pebbles, or fragments of chert, cemented with lime.

8.— *Well at the Postoffice.*

Gravel to the upper water.....	21 ft.
Gravel in water.....	35
Blue clay.....	8
Lower gravel (water).....	13
Total.....	77 ft.

For these well sections we are indebted to Mr. R. R. Rouse, of this city, who is engaged in the business of making tubed wells.

We took the following section of an exposed bluff on Fall creek, at the mill-dam, half a mile above Millersville:

Soil and subsoil.....	4 ft.
Yellow clay.....	5
Sand parting.....	1
Yellow clay, streaked with blue.....	10
Pale yellow clay.....	16
Compact dark blue clay to the water line.....	8
Total.....	44 ft.

How far the blue clay extends below the bed of the creek we have no means of knowing, as no borings have been made in the vicinity, and the creek no where in this county cuts through the clay to the rock in place.

Several fine exposures of this lower clay occur in the bluffs on the western side of White river, between Broad Ripple and Indianapolis, which afford an excellent opportunity for studying the character of this formation. The lines of deposition are, in places, well marked, but the entire absence of fossils is the most noticeable feature; for the material is well calculated to preserve organic remains. At one point in section 15, township 16, range 3, sixty feet of this clay is exposed, and yet it extends under the bed of the river indefinitely. Returning to the relation of the lower blue clay to the water supply of Marion county in general, and of the city of Indianapolis in particular, it is well to note the fact that the reservoir of water which this impervious bed of clay holds in place in the bowlders below it, has no outlet, except as it rises to the surface through fissures in the clay, and, therefore, can never be exhausted by natural

drainage. To procure it for domestic use it will be necessary to carefully exclude the surface water. To do this requires a tube passed so tightly through the clay as to admit of no transmission of water around it.

The location of Indianapolis—its constantly increasing railroad facilities, its inexhaustible supply of coal at a convenient distance, the near vicinity of great forests of hard wood, and its easy access to the raw material, marks it as a great manufacturing center, at no very distant period in the future. A supply of water for steam purposes, that shall be of easy access, constant and unfailling, is an indispensable requisite to this consumption; and this we have under every acre of land in Marion county. If the city can be supplied with river water, purified by filtration so as to make it potable, it is well; but the population will always have an alternative in the easy access to this lower fountain by tubed wells. Before dismissing this subject, it is well to say that in the clay sections of this county, which embrace all the table lands, there are many places where the upper bed of water-bearing sand is from twenty-five to thirty feet below the surface, and the clay above it is hard and compact. Here a tubed well will supply water of a fair degree of purity; but in an open well it is almost impossible to exclude surface-water when the soil becomes saturated. It will leak in and pass down behind the wall unobserved.

Marion county has no mineral wealth, but in its

#### CHARACTER OF SOIL

It has the potency and pledge of inexhaustible wealth. Our glacial drift furnishes the material for a soil that answers every agricultural demand. Being formed by the decomposition of almost every variety of rock, it holds the elements of all in such a state of fine division as to give it excellent absorbant properties, and enable it to retain whatever artificial fertilizers may be added. In its natural state the soil of Marion county, generally, has but one prominent defect; the very fine material of which it is made, lying so nearly level, becomes readily saturated with water, and having no means of exit beneath, except by slow percolation through the clay, the water is long retained. This necessitates the escape of a great part of it by

evaporation from the surface, and this, especially in the spring, arrests the warming of the soil and postpones the early preparation of it for the summer crop. This saturation has, also, an unfavorable effect on the vegetable matter in the soil, excluding it from free contact with the air, and thus arresting its rapid decomposition, and often converting it into humic acid, a chemical compound really injurious to crops. In the alluvial, or bottom lands, and in the terrace, or second bottom formations, this objection is relieved by a stratum of gravel or coarse sand a few feet below the surface, which rapidly transmits the water downward and relieves the saturated surface soil. The same effect is produced on the clay uplands by a system of tile drainage. Well-burnt tiles, of proper capacity to carry off the redundant water, sunk to the depth of three or four feet, in lines sixty feet apart, with a good outlet secured, will place even the most tenacious clay soil in a condition very much resembling bottom lands. Indeed, in some respects, well-drained upland is to be preferred to bottom land, as it is not so liable to injury from drouth, and it retains manures much better. The process of tile-draining the level clay lands of Marion county is progressing rapidly, and in a few years the whole county will present a plain of unsurpassed fertility.

#### WATER-COURSES.

White river has a course of twenty-two miles, on a direct line from its point of entry into the county to its place of exit, but following the meanders of the stream, the distance will be some ten miles greater. By an act of Congress, this stream was declared "navigable" to a point ten miles above the northern line of Marion county. When the white man first built his cabin here, White river was fordable but at a few points in the county, and that only for a short period in the autumn. But, with the change of the country from forests to cultivated fields, the river and its tributaries have undergone a corresponding change. Without assuming that there has been any material decrease in the rainfall, the streams have shrunk in their dimensions till the "navigable river" of the Congress of 1819, has become a mere rivulet a good portion of the year; and its tributaries, Fall creek and Eagle creek, from being mill



streams, furnishing ample power for propelling all needed machinery the year 'round, are now so low during the summer and fall months as to lose most of their value as mill streams. This shrinkage must be referred to several causes: First, clearing away the forest has greatly increased the evaporation, and a much larger per cent. of the rainfall now goes back into the atmosphere than formerly; second, the streams have been cleared of driftwood and other obstructions, so that the current is more rapid; third, ponds and marshes have been drained, so that these reservoirs, which formerly discharged their stored waters slowly for the whole year, now empty themselves at once, leaving no summer supply; fourth, the tile drainage of a wide extent of country is operating to dry up many of the superficial springs that furnished a summer supply to many brooks and rivulets that were feeders to the larger streams. These causes, operating together, give us more water in our winter and spring freshets, and reduce our streams correspondingly during the dry season.

Though the immediate bed of the principal streams of this county is composed of small bowlders, water-worn pebbles and sand, yet, but a foot below, these will be found resting on the blue clay, which is nearly impervious, so that there is but little loss to our streams by absorption. Though the country is comparatively level, yet the current of our streams is quite rapid. Counting the length of White river on a straight line through the county, it has a descent of nearly two feet per mile, and the fall of Eagle creek and Fall creek exceeds this. If it were not for the tortuous course of these streams they would be torrents. This, however, retards the current considerably, especially in White river, south of Indianapolis.

#### ARCHÆOLOGY.

We discovered no mounds nor earth-works indicating the residence of a prehistoric race in the territory now comprised in Marion county, though flint arrow heads, stone hatchets, chisels, and other tools of the ancient Stone age, are frequently found in the surface soil. This is especially the case in the southern part of the county, in the neighborhood of Glen's Valley. Many of these stone implements, or ornaments, are

made of talcose slate, a rock not found nearer to this locality than the Cumberland mountains, or the regions of Lake Superior, and many of these are of curious form, and if of use, we have not been able to discover what that use was.

The Delaware Indians had two towns in this county when first visited by the white man. The largest and most important of these was located on the high bluff west of White river, the town being divided by the line now separating Johnson and Marion counties. The inhabitants cultivated an island of some two hundred acres, immediately east of the town. This town was the residence of the Delaware chief, Big Fire, who was known as a firm friend of Governor Harrison and the white pioneers of this territory. Indeed, it was a dispute about the right of Big Fire to sell to the General Government a strip of land south of a line known, in early days, as the Boundary, that led to the hostility of the Miami and Shawnee Indians in 1811. It was this White river town that the Madison Rangers destroyed, in the fall of 1812, in revenge for the massacre of Pigeon Roost, in Scott county, perpetrated by a band of Shawnee warriors. This sad and unfortunate mistake in not discriminating between the innocent and the guilty, cost Governor Harrison no little trouble in convincing Big Fire that it was a mistake of the Rangers, to be attributed to their ignorance of the geography of the country. But few marks remain to identify the spot where once stood the most populous of the Delaware towns.

The other Indian village was located in the great bend on the east side of White river, in section 20, range 4, township 17. The location of the village, and the chief part of its cultivated ground, is now a forest of sixty years growth, and nothing but the tradition of the "Old Settlers" fixes the location of the town. A large spring breaks out at the foot of a hill bordering a piece of elevated bottom land, from eighty to one hundred rods wide. Around this spring the wigwams were built, and on the bottom land the squaws cultivated the corn, beans and pumpkins that served as a relish to the venison of the hunter. Near the river is an ancient cemetery, where the bones of many generations of hunters and warriors repose, except when the river encroaches on their resting place and exposes their re-

mains, which it frequently does. Last spring a freshet uncovered several pits, or ovens, excavated in a very compact clay, near this burying ground. They were about thirty inches in diameter and about the same depth. They had been burned till the inner surface was as hard as a brick. At the bottom of these pits were found coals and ashes, and around them were several fragments of pottery. This was probably a very old town.

#### NATURAL HISTORY.

The Botany of Marion county presents nothing peculiar. It was originally covered with a heavy forest of hard wood, among which not a single evergreen was found. On the undulating uplands the prevailing species were the Sugar Maple; White, or Gray Ash; Blue Ash; Black Walnut; Red Beech; Butternut; White Oak; Poplar, (*L. Tulipifera*); Wild Cherry, etc. On the flat uplands the timber consisted chiefly of Bur Oak; White Elm; Shellbark Hickory; White Beech; Water Ash; Red, or Soft Maple, etc. The alluvial and terrace lands (first and second bottoms) were covered with large trees of Black Walnut; Blue Ash; Hackberry; Buckeye; Sycamore; with abundance of grape vines, which often climbed to the top of the tallest trees. Beneath these forests there grew a dense mass of shrubbery, consisting chiefly of Spicewood; Paw-paw; Waahoo; Black Haw; Leatherwood; Prickly Ash, etc. In every place where the forest and shrubbery were sufficiently open to admit a glimpse of sunshine, the ground was covered with nettles, matted together with pea vines. Such was the primitive condition of this county when the "Red Man" hunted the deer here; but it is remembered only by a few surviving pioneers. The forests have dwindled down to a few patches of woodland, surrounded by cultivated fields; the undergrowth has entirely disappeared, and the nettles and pea-vines are botanical curiosities. A few spots have been preserved in their primitive wildness by those who love to remember the scenes of pioneer life, but even these will soon disappear.

Marion county once abounded in wild game, and the streams were well stocked with fish of all the varieties usually found in western waters. The Black Bear, the Gray and Black Wolf, Buffalo, the Deer, Raccoon, Fox, Gray and Fox-Squirrels, etc.

Wild Turkeys and Pheasants were abundant, and the woods were vocal with the songs of birds. It was indeed the paradise of hunters—but all these have disappeared; a few timid quails only, lead a precarious life, protected by stringent laws and the vigilance of farmers. The birds of song are nearly exterminated and their mellow notes superseded by the harsh scream of the English sparrow. The abundance of fish, for which White river and its tributaries were once noted, has greatly diminished, and would, perhaps, have entirely disappeared but for the protection of law and the watchful care of citizens who are personally interested in the enforcement of these laws.

We subjoin the following ideal section of the geology of Marion county, drawn from natural sections, borings and excavations made in various parts of the county. Beginning with the most recent formations, we have—

*Transported Material.*

1. Alluvium, or bottom land.....from 10 to 20 feet.
2. Terrace formations, gravel and sand.....from 50 to 100 feet.
3. True boulder clay (glacial).....from 40 to 110 feet.
4. Blue sedimentary clay and sand.....from 20 to 120 feet.
5. Boulders and gravel .....from 5 to 15 feet.

*Rock in Place.*

6. Knob sandstone (Carboniferous)..... 25 feet.
7. Genessee Slate (Devonian)..... 80 feet.
8. Corniferous limestone (Devonian)..... 50 feet.

The Corniferous limestone has been penetrated 50 feet, but its entire thickness at this point is undetermined, as its eastern out-crop is concealed by the heavy drift deposit. Numbers 1, 2, 6 and 7 underlie only portions of the county; the other members are general in their distribution.

## GEOLOGY OF DECATUR COUNTY.

By *MOSES M. ELROD, M. D.*

Decatur county lies in the southeast central part of the State. Greensburg, the county seat, is forty-seven miles southeast from Indianapolis, and sixty-eight miles from Cincinnati, on the main stem of the Cincinnati, Indianapolis, St. Louis & Chicago railway. The county is of an irregular shape, measuring twenty-two miles in greatest length north and south, and twenty-one miles in greatest width east and west, and has an area of 231,671 acres. It is bounded on the north by Rush, on the east by Franklin, on the south by Ripley and Jennings, and on the west by Bartholomew and Shelby counties.

The territory of which the county is composed was purchased by the government from the Delaware Indians at the treaty of St. Mary's, January 15, 1819, but was not surveyed and offered for sale to settlers till 1820. The first land patent issued from the Brookville, Indiana, land office for lands in Decatur county, bears date of October 3, 1820, and was granted to John Shelhorn for what is still known as the Shelhorn homestead, between Little and Big Flat Rock creeks, in Adams township.

The county was organized pursuant to an act of the Legislature, passed at the session of 1821-1822; prior to this time it formed a part of Delaware county.

The Cincinnati, Indianapolis, St. Louis & Chicago railway crosses the county from the east to the northwest; the Vernon, Greensburg & Rushville railroad through the central part, from south to north, and the west by the Columbus, Hope & Greensburg road. The county is well supplied with good pikes; the county seat has six, radiating from that center. Many of the

township roads are graveled and in excellent repair, affording splendid drives through fine farms and beautiful pasture lands.

Greensburg, with a population of about 4,000 inhabitants, is one of the handsomest cities in the State, noted for its healthfulness, wealth, intelligence, and the literary taste of its citizens. Many of its streets are thickly bordered with the most beautiful of all our native forest trees, the white and sugar maple, trees that are beautiful in blossom, beautiful in full, dark summer leaf, and resplendent in russet and gold when touched by the icy finger of autumn.

St. Paul, Clarksburg, Adams, Westport, Millhousen, Sardinia and Milford are thriving and pretty towns of 600 to 200 inhabitants. Kingston, New Point, McCoy, Rossburg, Mechanicsburg, Pennington, Smyrna, Waynesburg and Alert are smaller but enterprising villages. Nearly all the towns of the county are noted for their excellent public school buildings, a sure index of the intelligence and morality of the people.

TOPOGRAPHY.

TABLE OF ALTITUDES, DECATUR COUNTY.

*Vernon, Greensburg & Rushville Railroad, South of Greensburg.*

Miles from Greensburg.	POINTS AT WHICH THE ELEVATIONS WERE TAKEN.	Feet Above Ocean.
	Greensburg depot, C., I., St. L. & C. R. R. . . . .	954.00
1.3	Junction of C., I., St. L. & C. R., R., and V., G. & R. R. R. . . . .	939.00
1.7	Muddy Fork of Sand Creek bridge . . . . .	908.00
	Bottom of stream . . . . .	894.00
7.2	Horace Station . . . . .	868.05
8.9	Lett's Corner . . . . .	891.05
13.14	Westport . . . . .	801.05
15.14	Sardinia Crossing . . . . .	770.05
19.74	Brewersville bridge, Big Sand creek . . . . .	695.05
	Bottom of stream . . . . .	643.05
25.8	North Vernon at O. & M. R. R. Crossing . . . . .	721.08

*Vernon, Greensburg & Rushville Railroad, North from Greensburg.*

Miles from Greensburg.	POINTS AT WHICH THE ELEVATIONS WERE TAKEN.	Feet Above Ocean.
.50	Junction of C., I., St. L. & C. R. R., with V., G. R. R. . . . .	939.00
5.8	Sandusky Station. . . . .	939.00
7.0	Clifty Creek bridge. . . . .	934.00
	Bottom of stream . . . . .	904.00
8.8	Williamstown, county line . . . . .	954.05
11.7	Little Flat Rock Creek bridge. . . . .	958.00
	Bottom of stream . . . . .	935.00
11.8	Milroy . . . . .	963.00
15.3	Bennetts . . . . .	982.07
19.0	Big Flat Rock bridge. . . . .	951.05
19.5	Rushville junction with Cambridge branch J., M. & I. R. R. . . . .	955.06

*Columbus, Hope & Greensburg Railroad.*

.50	Junction of C., I., St. L. & C. R. R. and C., H. & G. R. R. . . . .	939.00
10.4	Clifty Creek bridge. . . . .	765.05
	Bottom of stream . . . . .	720.05
12.7	Duck Creek bridge. . . . .	758.03
	Bottom of stream . . . . .	723.03
15.2	Hope . . . . .	737.04
26.6	Columbus, West end of Water street. . . . .	629.01

*Points on C., I. St. L. & C. R. R., in Decatur County.*

10.0	St. Paul. . . . .	864.00
	Flat Rock bed . . . . .	792.00
	Clifty Creek bed . . . . .	860.00
6.0	Adams . . . . .	892.00
	Greensburg . . . . .	954.00
	Sand Creek bed . . . . .	939.00
3.0	McCoy's. . . . .	1,039.00
6.0	Smith's Crossing . . . . .	1,015.00
8.0	New Point. . . . .	993.00

*Other Points in the County.*

	Harris City, end of switch at quarry . . . . .	854.00
	Summit between Sand creek and Salt creek—old survey of Lawrenceburg & Indianapolis Railroad, 1835 . . . . .	1,079.00
	Summit of divide at Clarksburg . . . . .	1,034.00
	Top of Lower Silurian at Rossburg . . . . .	953.00
	Top of Lower Silurian below Harris City . . . . .	834.00
	Top of Lower Silurian at Douglas Hole, Clifty creek . . . . .	884.00

The summit between Sand creek and Salt creek, on the line of the preliminary survey of the Lawrenceburg and Indianapolis railroad, made in 1835, as given above, 1,079 feet, is the highest point yet determined in Southeastern Indiana. McCoy's, on the present line of railroad, is the highest point on that road, and is thirty feet higher than Pierceville, on the O. & M. R. R. Through the county east of Greensburg, runs the divide that determines the natural drainage of the country to the east into White Water, and west into East White river. From the dividing ridge the lands fall away to a lower level, as they near the county lines; but in a much more marked degree on the southwest and west. Taking the summit above referred to as 1,079 feet above tide level, for comparison, Sardinia crossing is seen to be 301 feet lower; the Clifty creek bridge, on the C. H. & G. R. R., is 314 feet lower; St. Paul, 215 feet lower; and Williamstown, at the county line, 125 feet lower. Notwithstanding the great difference in the level of these points, the change from one to the other is so gradual as scarcely to be noticed by the casual observer, and taking the county as a whole it may be designated as "upland." The surface of the country is undulating, broken on the creek banks by bluffs that are usually covered with clay and gravel. The creek beds, first and second bottoms, are lower than the general level of the country, and their bluffs mark the limits of the ancient river beds. The bluffs are usually spoken of as hills, but, in the sense of an elevation above the general level, the use of the term hill is inapplicable. On Salt creek, Cobbs' Fork, Sand creek, Clifty creek, and tributary branches about Newburg and Flat Rock, near the boundary lines of the county, the creek bluffs are much higher than in the interior. The white clay lands of the east and southeast part of the county are "upland flats," in many places too level for efficient natural drainage. True hills, or rather, low elevations above the common level, are found in parts of Jackson township.

#### DRAINAGE.

As indicated above, the dividing ridge of the eastern part of the county determines its drainage, and the course of its creeks and the falling away of the general level of the country deter-



mines their velocity. From the bridge on the C., I., St. L. & C. R. R., over Sand creek to Brewersville, a distance of twenty-five miles, the creek has a fall of 296 feet, an average of about twelve feet to the mile. From Adams to the C., H. & G. R. R. bridge, Clifty creek has a fall of 140 feet in ten miles, fourteen feet to the mile. The "flat lands" north of New Point are drained by Salt creek and its branches, that flows south; thence northeast through Franklin county into White Water; those south of New Point, by Laughery creek, that joins the Ohio below Aurora, and the northern headwater branches of the Muscatatuck river. Through Sand creek and its branches, Rocky creek, Painter creek, Cobb's Fork, Muddy Fork, Millstone, Wyanouse, and others of less note, the drainage of the central and southwest part of the county is effected. Clifty creek and tributaries, North, South and Middle Forks, and Fall Fork, are the principal creeks of the west. From a study of the map it is seen that Decatur county is well supplied with creeks that have their origin within its limits, and owing to the topography of the country, flow to the east, south and west, and for the same reason is not traversed by any important stream that deserves the name of a river, except it be Flat Rock, that cuts through Adams township in the northwest corner of the county. As would naturally be expected, the streams of the central and northern part of the county have low banks that do not cut through the gravel and clay, but grow deeper and rocky as they cross the county lines. The bed of Flat Rock is seen by railroad elevations to be seventy-two feet below the level of St. Paul; Clifty creek, thirty-two feet below Adams, and forty-five feet below the bridge of C., H. & G. R. R. To the rule of the gradual increase of the height of the banks and bluffs of the creek, there is a marked exception in the case of Salt creek that reaches down to the Lower Silurian shales and soft limestones, cutting deep and abrupt gorges for its passage.

## PALÆZOIC GEOLOGY.

## DIP.

The junction of the Lower and Upper Silurian, Hudson River and Clinton groups, is a well-marked and easily recognized horizon, and advantage has been taken of this fact to determine the altitude of three points in the county for comparison. These determinations have been made with a reasonable degree of accuracy, by connecting the points selected with the adjoining railroad elevation. Especially may those at Rossburg and Harris City be relied on as correct. The junction of the two groups at Rossburg was found to be 953 feet above the ocean; Harris City, 834 feet, and that at Douglas Hole, on Clifty creek, near Sandusky, 884 feet. The average of the altitude is 890 feet, which gives a difference of twenty-five feet when compared with 915 feet, the average of thirteen determinations made by Prof. Orton,\* in Montgomery, Preble, Miami, Clark, Greene and Warren counties, Ohio, low water in the Ohio river, at Cincinnati, being assumed at 410 feet above the sea level. Omitting the observation at Harris City, that is evidently shown to be below the general level of the Cincinnati Lower Silurian arch, by the dip of the overlying Niagara group limestone, the average of the two remaining points, Rossburg and Douglas Hole, is 908 feet, a difference of seven feet less than that of Ohio; and I have no doubt but the Douglas Hole should be also omitted, as not being an exposure of the top of the plain of the arch, but of the slope on the west side. The divide that runs northeast from McCoy's Station, through Kingston and Clarksburg, is probably the western crest of the Lower Silurian upheaval. This being the fact, Rossburg falls within the plain, and does not show any appreciable dip to the west of the top of the Hudson River group, from the vicinity of Dayton, Ohio, to the east side of Decatur county. On the contrary, it has a greater altitude than the average of those of Ohio, but not greater than the average of the six

\* Geological Survey of Ohio. Geology, vol. 1, p. 411, *et seq.*

highest points. At Hollinsbe's quarry, just west of Rosburg, the exposed surface of the Niagara flags has a decided dip to the northeast, but this is probably local.

Estimates of the dip of the Niagara group have been made by taking the junction of the top of the limestone with the calcareous Waldron shale as the horizon. Measurements show the base of the Waldron shale at the Clifty creek V., G. & R. R. bridge to be 20 feet above the bottom of the stream, which, reduced to the railroad level, is 924 feet above the ocean. The same process shows the shale under the St. Paul bridge over Flat Rock to be 819 feet; the difference in the level is 105 feet, the distance 8 miles due west, and the dip over 13 feet to the mile. From the V., G. & R. R. bridge, mentioned above, to the C., H. & G. R. R. bridge over Clifty creek is 13 miles southwest, the difference in elevation is 187 feet, and the dip over 14 feet to the mile. From these and other observations it is probable that the greatest dip is to the southwest, at about 15 feet to the mile.

#### CONNECTED SECTION.

The following general section shows the average thickness of the strata of clay, gravel and rock exposed in the county brought together in one ideal view.

#### *General Section of Decatur County.*

##### QUARTEARNARY AGE.

Recent period.....	8 ft.
Drift period.....	40

##### DEVONIAN AGE.

##### CORNIFEROUS GROUP.

Blue crystalline, North Vernon quarry stone, wanting..	00 ft.
Gray limestone, Middle Corniferous.....	6
Magnesian limestone, Lower Corniferous.....	35

UPPER SILURIAN PERIOD.

NIAGARA GROUP.

Calcareous shale, Waldron fossil bed.....	6 ft.
Chert, rubble and flag .....	15
Drab quarry stone.....	25
Lower Niagara shale, flag and marl.....	10

CLINTON GROUP.

Calcareous sand-rock and flag.....	3 ft.
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LOWER SILURIAN PERIOD.

HUDSON RIVER GROUP.

Limestone, shale and marl.....	25 ft.
Total.....	<u>173 ft.</u>

LOWER SILURIAN DIVISION.

HUDSON RIVER GROUP.

The top members of this group outcrop in the bed of Sand creek, from Parker's mill, southeast of southeast, section 32, township 10, range 9 south, to the Jennings county line, except where covered by sand and gravel; on Painter creek, below the Boicourt Brothers' quarry, along the lower course of Rocky creek, in the bed of the North Fork of the Muscatatuck and Squaw creeks, near the Ripley county line, and on Salt creek and its branches. At no point in the county is the Hudson River group the surface stone of the general level of the country, but it is not buried very much below the common level on the boundary line east of Sand creek and on the Franklin county line. It is the outcropping fringe or border on the south and east of the more elevated and central parts of the county. Fossils found in the gravel and sand below the Douglas Hole, on Clifty creek, and below the Picayune mills, at Downeyville,

on Little Flat Rock, show that the water at these places reaches down to the Lower Silurian, and that the rocks of this age are not far below the surface on the north side of the county.

In lithological structure it is made up of buff, drab, blue or greenish shale or marl, intercalated with a few strata of semi-crystalline limestone, that seldom or never exceed six inches in thickness. In proportion, the limestone exceeds the shale and marl combined, but on account of frequent vertical fissures is of very little or no economic value. Where exposed, the marl and soft shales weather to sticky, unctuous clay, leaving the bands of limestone unsupported, that drop of their own weight, and hence undermine the overhanging cliff of the Niagara Group.

## UPPER SILURIAN DIVISION.

### CLINTON GROUP.

At the base of the Niagara Group, and underlying the Lower Niagara shale, marl or flags, at all the outcrops seen in the county where the Upper and Lower Silurian form a junction, there is found a bed of calcareous sand-rock, or shale, ranging in thickness from six inches to three feet. Where reduced to a single stratum of a few inches in thickness, as is frequently the case, to the unaided eye it has more the appearance of hard blue sandstone, slightly weathered on the outside to an ochrey color, than a limestone. Tested with mineral acids, the residue, from five to ten per cent. of the whole mass, is found to be siliceous. Examined with the microscope, the sand grains are found to be worn and irregular in outline, unlike quartz crystals. Where the beds are thicker and more shaly, as at Parker's mill, below Harris City, the formation has a much greater proportion of sand, and the color varies to yellow or drab throughout the whole stratum.

### NIAGARA GROUP.

Underlying the building stone of this group are frequently seen thin strata of shale, flag, and thicker beds of marl that I

have designated as the Lower Niagara shale, to distinguish it from the Upper or Waldron shale. The intercalated flags of the lower shale are of the same general appearance, bedding and structure, as the overlying beds of Niagara stone. The shale is found in thin strata of thinner laminae. The marl, where seen in place or recently exposed, is blue; where weathered, it breaks down into a very friable, fine clay that, dry, much resembles an ash pile. These shales and marls, and, in fact, all the shales of the county, whether Lower or Upper Silurian, are generally called, by the quarrymen and others, soapstone; but as the latter term has been applied by mineralogists to a very different stone, its use to indicate shale should be dropped; and the same objection applies to the term slate. The Lower Niagara shale is seen in the outcrops on Salt creek and its tributaries, and on Sand creek. These beds are not exposed on Clifty creek or Flat Rock, except, perhaps, in the Lowe quarry at St. Paul.

The true Niagara building stone is not alone of interest as forming nearly the whole of the surface rock immediately underlying the clay and gravel of the east half of the county, but on account of its vast importance from an economic point. The quarry stone is exposed in the banks of Salt creek and branches, north fork of the Muscatatuck, Squaw creek, and Sand creek and all its tributaries, in the bed of Clifty creek and in the banks and bluffs of Flat Rock and Little Flat Rock creek. The best exposures of the main central beds are found on Sand creek, Cobb's Fork, Painter creek, and Rocky branch, embraced within a triangle formed by drawing a line from Greensburg to Millhousen; and from Greensburg to Westport. At the quarry of the Greensburg Limestone Company, Harris City, twenty-four feet nine inches of clear merchantable stone is taken out, and about the same extent of good stone is exposed at the quarry of Z. Boicourt on Sand creek, near Westport. The main central beds are free from the overlying chert and rubble of the west side of the county. The quarries of the east part of the county are opened at the base, and those of the west part at the top of the formation. The quarries of Fugit, Salt creek, Marion and Sand creek townships, are covered only by earth and gravel; those of Adams, Clay and Clinton townships, except in the bends of the

creek bottoms, by the base of the Corniferous group; the thickness of the overlying Corniferous varies from a few inches to more than thirty feet. Prof. Collett, in his report on Shelby county, 1881, makes the thickness of the Niagara limestone in Mr. Lowe's St. Paul quarry, twenty-nine feet ten inches, and my measurement just below the railroad bridge over Flat Rock, one mile below Mr. Lowe's, gives a thickness of twenty-seven feet. In these two sections the top beds are respectively fourteen and fifteen feet of chert and rubble.

I have estimated the thickness of the Niagara limestone at forty feet; twenty-five feet of this is clear quarry stone. It is probable that the total thickness of the group grows less to the northeast, near the top of the Lower Silurian Arch, and that the thinning out is at the expense of the top, cherty member.

In physical appearance, the Niagara limestone has been described as of a light blue, or light gray, drab and buff, or drab and gray color. The best quarry stone is of a uniform drab, or light blue. The drab colored stone weathers to a buff, and exposed specimens of more than two inches in thickness, when broken across, show a drab center. In chemical composition it is a magnesian limestone, in which the percentage of carbonate of lime exceeds the carbonate of magnesia. With the above is mixed a small per cent. of alumina, but not in proportion to detract from its value in making a strong "hot" quicklime, and about five per cent. of insoluble silicates. Mineralogically it is a dolomite, semi-crystalline in structure. The stratification is massive, the bedding even, thin to medium heavy, and at a few places very heavy. The middle beds are usually homogeneous, the top beds mixed with nodules, and bands of chert. In the stone south of Greensburg, about twelve feet above the Lower Niagara shale, is found a very persistent bed of stone, ranging from two to three feet in thickness, that has, scattered through it or aggregated in the horizontal seams, a few nodules of chert, but not in sufficient quantity to impair its value for bridge building; all the other ledges are free from flint. The thickest beds of massive stone are found on Clifty creek, and at St. Paul; the thinnest beds on Little Flat Rock, and the head waters of Clifty. Heavy beds are found at all points, but not in such large proportion to the whole number of strata. Where exposed and weathered, the outcrop presents

a rough perpendicular wall of "cliff rock," without any accumulation of fallen fragments at the foot. The beholder is impressed with the idea, and truly, that the rains and frosts of many winters have done but little to destroy these foundations of the everlasting hills.

The Upper Niagara shale bed, is the calcareous clay, shale and thin strata of limestone overlying the quarry stone, and closing the Niagara period and group. The greater per cent. of the mass is carbonate of lime. In Shelby county, they are known as the Waldron beds. In my report on Bartholomew county, I generally called this formation Calcareous shale, which is appropriate so far as chemical composition is concerned, but the presence of another calcareous shale at the base of the Niagara group in this county, not seen in Shelby and Bartholomew, necessitates the use of a more specific term. Following the rule of priority, Waldron being the place where the Upper Niagara bed fossils were first found and studied, I shall refer to it by the name of Waldron shale. In general it is made up of thin laminae of shale, frequently erroneously called slate, with bands of limestone near bottom; and where constantly wet, the shale is replaced by clay. Where exposed to atmospheric influences it weathers to a buff or ochrey-colored friable clay, scarcely distinguishable from the surrounding yellow clay; where protected, the color is uniformly a drab or blue, with occasional streaks of green. The Waldron shale is not uniformly found at all the places where both the Niagara and Corniferous groups outcrop. It was seen only on Clifty creek and Flat Rock, in the west and northwest parts of the county. In thickness, it ranges from ten inches to six feet. At certain places the upper shale is highly fossiliferous, as at St. Paul, and at Hartsville, less than one mile west of the Decatur county line; at some points no fossils could be found, and very few at others.



## DEVONIAN AGE.

## CORNIFEROUS GROUP.

In my report on the geology of Bartholomew county, 1881, for convenience of study, and on account of the marked difference in general appearance and structure of the rocks of this group, they were divided into Upper, Middle and Lower Corniferous. The upper member, the equivalent of the North Vernon quarry stone, does not reach Decatur county, the nearest approach being four and one-half miles west of the county, on an air line from Greensburg to Columbus. The Middle Corniferous was only seen in one outcrop in the southwest corner of Clay township, on the farm of John Graham, southwest of southwest, section 30, township 10, range 7, where a knoll of highly fossiliferous, shelly, gray limestone is exposed to the surface, and has been quarried for light work. On Bear creek, just after it crosses the county line, and west of Alert, the same range of stone is found, and has been hauled into the county for macadamizing purposes.

The Lower Corniferous, but for the overlying drift, clay and gravel, is the surface stone of nearly the whole west half of the county. The Niagara and Corniferous groups are seen, either singly or together, at every outcrop or exposure. It is the only stone seen in Jackson township, except at the southeast corner. It is the surface stone of Clay, Adams, and the west parts of Washington, Clinton and Sand Creek townships, and is the only stone exposed in the beds of Fall Fork and Middle Fork creeks. It is the rock struck in sinking wells at Greensburg. The line on the map indicating the eastern limits of the Corniferous, is an average of the outcrops where it is drawn, and stone of this group is found to the east of it at many places, especially in Washington township.

To the unaided eye the Lower Corniferous rock has the appearance of sandstone, and it is frequently so called by the quarrymen. Examined with a magnifier it is found to be made up of minute crystals of carbonate of lime and earthy matter; tested with strong acids, it is dissolved without any residue showing the presence of sand. The amount of earthy matter

or alumina in it varies, but not sufficiently to change the general appearance of the stone. Where found in thin, even laminæ, or beds, the earthy constituent is increased. It breaks into irregular blocks, is with difficulty quarried in regular pieces, and when blasted, blows out or shells into small fragments. In structure it is not homogeneous; exposed in high walls and cliffs it weathers into small holes and pockets that afford nesting places for the wood pewee, or footholds for columbine and other plants. The cliffs at a distance have the appearance of a hard, gray rock, covered with lichen and moss; struck with the hammer it crumbles to powder; partially or wholly protected by a damp soil, it disintegrates to a fine rottenstone. In the vicinity of Greensburg, the lower beds are more crystalline than the average specimens of the whole group, are coarser in appearance, with a greater tendency to shell and break into fragments with thin edges. Typical specimens of the last variety may be seen in the banks of the Town Fork of Sand creek, in Greensburg, near the cemetery, and of the average stone at Milford. Chemically, it is a magnesian limestone. The general color is a sodden buff.

*List of Fossils found in Decatur County.*

LOWER SILURIAN.

HUDSON RIVER GROUP.

RADIATA.

POLYPI.

<i>Monticulipora approxematus</i> .....	Nicholson.
<i>Monticulipora briareus</i> .....	Nicholson.
<i>Monticulipora dalii</i> .....	Edwards & Haime.
<i>Monticulipora mammillata</i> .....	D'Orbigny.
<i>Monticulipora rugosa</i> .....	Edwards & Haime.
<i>Monticulipora pulchellus</i> .....	Edwards & Haime.
<i>Monticulipora sub-pulchellus</i> .....	Nicholson.
<i>Protarea vetusta</i> .....	Hall.
<i>Streptelasma corniculum</i> .....	Hall.

## MOLLUSCA.

## BRACHIOPODA.

<i>Orthis biforata</i> , var. <i>lynx</i> .....	Eichwald.
<i>Orthis occidentalis</i> .....	Hall.
<i>Orthis sinuata</i> .....	Hall.
<i>Orthis testudinaria</i> .....	Dalman.
<i>Rhynchonella capax</i> .....	Conrad.
<i>Rhynchonella ventricosa</i> .....	Hall.
<i>Strophomena alternata</i> .....	Conrad.
<i>Streptorhynchus (Strophomena) planoconvexus</i> .....	Hall.
<i>Streptorhynchus filitextus</i> .....	Hall.
<i>Zygospira modesta</i> .....	Say.

## PTEROPODA.

<i>Tentaculites richmondensis</i> .....	Miller.
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## GASTEROPODA.

<i>Murchisonia bellicincta</i> .....	Hall.
<i>Raphistoma (Pleurotomaria) lenticulare</i> .....	Emmons.
<i>Bellerophon bilobatus</i> .....	Sowerby.

## LAMELLIBRANCHIATA.

<i>Ambonychia costata</i> .....	James.
<i>Orthodesma rectum</i> .....	H. & W.
<i>Modiolopsis pholadiformis</i> .....	Hall.

## UPPER SILURIAN.

## CLINTON GROUP.

## BRACHIOPODA.

<i>Meristina intermedia</i> .....	Hall.
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## NIAGARA GROUP.

## PORIFERA.

<i>Astylospongia præmorsa</i> .....	Goldfuss.
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## POLYPI.

<i>Favosites forbesi</i> var. <i>occidentalis</i> .....	Hall.
<i>Favosites niagarensis</i> .....	Hall.
<i>Favosites favosus</i> .....	Hall.
<i>Favosites spongilla</i> .....	Rominger.
<i>Stromatopora concentrica</i> .....	Goldfuss.
<i>Strombodes pentagonus</i> .....	Goldfuss.
<i>Cyathophyllum radricula</i> .....	Rominger.
<i>Eridophyllum rugosum</i> .....	Edwards & Haime.

## CRINOIDEA.

<i>Eucalyptocrinus crassus</i> .....	Hall
<i>Eucalyptocrinus cælatus</i> .....	Hall.

## BRYOZOA.

<i>Lichenalia concentrica</i> .....	Hall.
<i>Fenestella parvulipora</i> .....	Hall.

## BRACHIOPODA.

<i>Atrypa reticularis</i> .....	Linnens.
<i>Retzia evax</i> .....	Hall.
<i>Anastrophia vernuili</i> .....	Hall.
<i>Eichwaldia reticulata</i> .....	Hall.
<i>Orthis hybrida</i> .....	Sowerby.
<i>Orthis elegantula</i> .....	Dalman.
<i>Meristina maria</i> .....	Hall.
<i>Meristina nitida</i> .....	Hall.
<i>Rhynchonella indianensis</i> .....	Hall.
<i>Rhynchonella stricklandi</i> .....	Sowerby.
<i>Rhynchonella neglecta</i> .....	Hall.
<i>Rhynchonella whitii</i> .....	Hall.
<i>Rhynchonella acinus</i> .....	Hall.
<i>Rhynchotretra cuneata</i> var. <i>americana</i> .....	Dalman.
<i>Spirifera crispa</i> .....	Hall.
<i>Spirifera eudora</i> .....	Hall.
<i>Spirifera radiata</i> .....	Sowerby.
<i>Strophomena rhomboidalis</i> .....	Wahlenberg.
<i>Strophomena striata</i> .....	Hall.

## PTEROPODA.

*Tentaculites niagarensis*.....Hall.

## GASTEROPODA.

*Platyostoma niagarensis*.....Hall.

*Platyostoma plebium*.....Hall.

*Strophostylus cyclostomus*.....Hall.

## CEPHALOPODA.

*Gyroceras elrodi*.....White.

*Orthoceras annulatum*.....Sowerby.

*Orthoceras crebescens*.....Hall.

*Orthoceras*.....Sp.?

## DEVONIAN AGE.

## CORNIFEROUS GROUP.

## RADIATA.

## POLYPI.

*Acervularia davidsoni*.....Edwards & Haime.

*Amplexus yandelli*.....Edwards & Haime.

*Blothrophyllum decorticatum*.....Billings.

*Cystiphyllum vesiculosum*.....Goldfuss.

*Cyathophyllum corniculum*.....Rominger.

*Cyathophyllum rugosum*.....Edwards & Haime.

*Favosites limitaris*.....Rominger.

*Favosites epidermatis*.....Rominger.

*Stromatopora tuberculata*.....Nicholson.

*Stromatopora nodulata*.....Nicholson.

*Zaphrentis gigantea*.....Rafinesque.

## MOLLUSCA.

## BRACHIOPODA.

*Atrypa reticularis*.....Liineus.

*Rhynchonella tethys*.....Hall.

*Spirifera oweni*.....Hall.

*Strophodonta demissa*.....Hall.

## GASTEROPODA.

- Bellerophon patulus*.....Hall.  
*Euomphalus decevi*.....Billings.  
*Loronemu nexile*.....Phillips.

## LAMELLIBRANCHIATA.

- Conocardium trigonale* .....Hall.

## CRUSTACEA.

- Phacops bufo*.....Green.

The foregoing list is very incomplete in the number of species that might be found in the county. Doubtless many of the more rare forms will be picked up when careful search is made. Messrs. George Dunn, postmaster; Jo. Drake and Jas. Davidson, of Greensburg, have some nice native specimens from the Lower Silurian. Mr. Drake has a *Calymene senaria*, Conrad, said to have been found in the county, and I have some fragments of a trilobite, probably an *Asaphus gigas*, DeKay, from Sand creek, near Parker's mill. A fine specimen of an encrinite, from the Hudson river group, has been found on a branch of Salt creek, at Rossburg. Mr. Davidson has a stone containing hundreds of *Zygospira modesta*, Say, and Mr. Dunn a beautiful slab covered over with *Orthis testudinaria*, Dalman, that came from Little Flat Rock, near Downeyville, washed from the Lower Silurian shale, exposed in a deep hole below the mill, southeast of southeast, section 6, township 11, range 9.

## LOCAL GEOLOGY.

Section at Wm. M. Hamilton's Quarry, Fugit Township.

Southeast of section 4, township 12 north, range 11 east.

Rubble and covered space, Niagara group.....	00 ft.	00 in.
Cherty limestone.....	00	4
Flag .....	00	4
Flag .....	00	4
Chert .....	00	2

Limestone and chert.....	00 ft.	4 in.
Dimension stone.....	00	6
Dimension stone.....	1	00
Flag.....	00	4
Flag.....	00	2
Dimension stone.....	00	6
Thin flag.....	1	00
Lower Niagara shale.....	1	00
Flag and shale.....	00	00
Total.....	6 ft.	00 in.

This quarry, if not the most northeasterly exposure of the Niagara stone in the county, is the only quarry in that vicinity that has been opened. Six feet does not represent the amount of available stone here buried in the bluff, and the higher ledges will probably be found to contain less chert-bands and nodules. Much of the stone here seen, from external appearance, seems to be an excellent building rock. The section was not continued down the creek to the Clinton beds and Lower Silurian, but I was told by Mr. James Holtsey, who has paid attention to the geology of that region, that it was not far down the creek to a point where Hudson River fossils are found. The overlying weathered gray bowlder clay here has considerable thickness, judging from the height of the adjoining bluffs, and is covered by a growth of a better class of timber than that seen on a corresponding soil farther south.

*Section at Larkin Waters' Quarry, Fugit Township.*

Northeast of section 21, township 11, range 11 east.

Soil.....	00 ft.	00 in.
Thin bedded light flags, Niagara group.....	1	00
Chert.....	00	2
Thin flagging.....	1	6
Flag.....	00	3
Dimension stone.....	00	8
Dimension stone and flag.....	00	10
Dimension stone.....	00	10
Buff-weathered stone.....	00	2
Shaley marl, Lower Niagara shale.....	1	8
Total.....	5 ft.	5 in.

This section was taken a few feet west of the Franklin county line. Underlying the shaley marl are beds of hard stone, and down the creek a few yards was seen a buff-colored ledge, about eight inches thick, that probably belongs to the Clinton group. Underneath this ledge characteristic Lower Silurian fossils were seen. The marley shale weathers to a fine ashen powder where protected from moisture, at other places to a sticky clay. Considerable quantities of stone have been taken out, and it is quarried with facility with drills and crow-bars.

*St. Maurice Quarry, Fugit Township.*

Southeast of section 31, township 11, range 11.

Soil, thicker back in the bluff.....	8 ft.	00 in.
Flag and rubble, Niagara group.....	1	10
Dimension stone.....	00	8
Flag and chert.....	00	3
Flag.....	00	4
Ledges with chert band in middle.....	00	10
Dimension stone.....	1	6
Dimension stone.....	00	7
Dimension stone.....	00	10
Dimension stone.....	00	8
Total .....	10 ft.	6 in.

But little quarrying has been done at this place, scarcely enough to show the true quality of the stone. The bedding is not quite so regular as at some other quarries but once fully opened up will improve. The creek, a branch of Salt creek, runs over the bed, and, by erosion, has left the ledges exposed in descending order, and, might be worked with great facility. The stone for the St. Maurice Catholic church was obtained here, also that for some lighter buildings in the neighborhood. The outcrop was not traced to the Lower Silurian that is known to come to the surface at a short distance southeast, in the bottom of the creek.



*Section at W. Hollensbe & Sons' Quarry, Salt Creek Township.*

Southwest of southwest, section 8, township 10, range 11.

Earth and gravel, boulder clay.....	4 ft.	00 in.
Rubble or flag.....	00	3
Rubble or flag.....	00	4
Rubble or flag.....	00	4
Flag.....	00	3
Flag.....	00	6
Dimension stone.....	00	7
Flag.....	00	3
Dimension stone.....	00	8
Dimension stone, or heavy flag.....	00	6
Dimension stone.....	00	10
Dimension stone.....	00	4
Block bridge stone.....	00	10
Flag.....	00	2
Dimension stone, free from chert.....	00	9
Dimension stone.....	00	9
Dimension.....	00	7
Marley clay, Lower Niagara shale.....	00	2
<b>Total.....</b>	<b>12 ft.</b>	<b>1 in.</b>

This section, like the Hamilton, Water's and St. Maurice quarries, is on a branch of Salt creek, and on account of facility in working and shipping; is the most important and noted of any on the east side of the county. Besides what stone is sold in the yard to supply the local demand, large quantities are regularly hauled to the railroad, one mile south, at New Point, and shipped to Cincinnati, Indianapolis, and other cities. The various ledges are even in bedding, never tight, and free from vertical seams or faults. The stone is a uniform drab or blue, homogeneous in structure, and easily worked with the hammer, where further dressing is required. The mass of the quarry is about twenty feet below the level of the railroad track at New Point, and might be connected by a switch at a small expense; however, this want is but a small drawback in the summer, when the roads are solid. The natural drainage of the quarry is very good, and but little stripping required to

reach the stone. At the time of my visit, seven workmen, with a full outfit of drills, crowbars, hammers, etc., were at work taking out stone.

As may be seen by the section, the outcrop here is a part of the lower numbers of the Niagara group. The section is not continued down to include all the Lower Niagara shale and thin flags that probably have a thickness of six feet. Following the creek branch to the east, a stratum of hard, buff stone is passed that is referred to the Clinton, and lower down, near Rossburg, the Lower Silurian is exposed. Below Rossburg, opposite the farm of Mr. Topmiller, is an upper, buff-colored shale, and an under blue shale and limestone, both filled with well-preserved specimens of Hudson River (*Cincinnati* group) fossils.

*Section on the North Fork of the Muscatatuck, Salt Creek Township.*

Southwest of southwest, section 26, township 10, range 10.

Covered space and rubble, Niagara group.....	00 ft.	00 in.
Dimension stone.....	00	8
Dimension stone.....	00	4
Dimension stone.....	90	10
Dimension stone.....	00	10
Dimension stone or flag.....	00	3
Dimension stone.....	1	6
Total.....	4 ft.	4 in.

This section was taken on the road east of Layton's mill, and does not represent the full thickness of the Niagara group stone outcropping in the bed and banks of the creek before the Lower Silurian shale is reached, further south. A quarry of twelve feet of most excellent stone can be opened in this vicinity that can be worked with ease and very little labor in stripping, as the overlying white clay is thin and the creek banks low. On the road from Layton's mill to the creek quantities of gravel are seen, that from its physical appearance, and the absence of the fossils so common in the Corniferous group flint, I think must be derived from the eroded beds of the Niagara, that long years ago were much thicker than they now are: the limestone

has been dissolved out and the more persistent chert is left in irregular, angular fragments, to tell the tale of decay that has been going on for ages.

At Millhousen, Marion township, between the Catholic church and the town, are extensive outcrops of most excellent quarry stone, that has been worked to supply the local demand. South of Millhousen, in the bed of a branch of Squaw creek, was seen the surface exposure of a stratum of blue limestone that was without a vertical seam at fault in 200 feet, level as a threshing floor and clean as a polished doorstep.

*Section on Squaw Creek, Marion Township.*

Southeast of northeast, section 30, township 9, range 10 east.

Covered space, thin clay and gravel.....	00 ft.	00 in.
Niagara group limestone, in even beds from two to ten inches thick.....	12	00 in.
Lower Niagara shale and flag.....	6	00
Place of the Clinton group, covered.....	6	00
Lower Silurian shale and limestone.....	10	00
Total.....	34 ft.	00 in.

Accumulations of chert were seen here, and at other places near by, like that before described as occurring in Salt Creek township. These accumulations remind one of the masses of angular stone and gravel seen in the St. Louis limestone regions, and are probably due to the same causes. Those in Decatur county are always on the top of the bluff, above the influences of any currents of water that have flowed in the vicinity in recent times. This section was taken near the Ripley county line, and shows the junction of the Niagara period and Hudson River group. Large numbers of well-preserved crinoid stems in the limestone indicate that a careful search would likely result in finding good specimens of encrinurites.

In sections 2, 10, 11 and 12, township 9, range 9, and section 7, township 9, range 10, Marion township, are extensive outcrops of Niagara group building stone in the banks of Cobb's Fork of Sand creek and Rocky Branch of Cobb's Fork.

On the farm of William Magniss, section 12, some little

prospecting and quarrying has been done—enough to show that in the vicinity are inexhaustable beds of first-quality stone, ranging in thickness from two to eighteen and twenty-four inches; evenly bedded, uniform in structure, free from flint and easily quarried. In developing quarries on Cobb's Fork, the expense for stripping and drainage can be put at a minimum, nature having already done that part of the work.

Railroad facilities for shipping are all that is needed to develop this region into one of the greatest quarries in the county, and this want could be supplied, and will be, in the near future, at a comparatively small expense. In the construction of the coming houses that are to take the place of the present wooden structures, stone and brick will be the principal material.

The quarry business in Indiana is in its infancy; builders are just finding out the vast storehouses of material scattered over the country, and especially in Decatur county. In a few years at most, the *banks* of Cobb's Fork and branches will be paying dividends little dreamed of by the present owners.

*Ducrow & Gleason's Quarry, Sand Creek Township.*

Southwest of section 5, town 8, range 9.

Covered space.....	00 ft.	00 in.
Flag.....	00	4
Flag.....	00	3
Flag.....	00	4
Flag.....	00	6
Flag.....	00	2
Flag.....	00	2
Flag.....	00	3
Flag.....	00	3
Dimension stone.....	00	9
Dimension stone.....	00	6
Dimension stone.....	00	6
Dimension stone.....	00	6
Dimension stone.....	1	3
Marley clay, lower Niagara shale.....	1	2
Flagging, thin ledges, estimated at.....	3	00
Hard buff stone, Clinton group.....	00	8
Lower Silurian shale and limestone, about.....	20	00
<b>Total.....</b>	<b>30 ft.</b>	<b>11 in.</b>

This section was taken on the west side of Sand creek, near the top of the bluff, and does not represent the total thickness of the available stone that will be exposed as the work is carried back from the creek.

About thirty hands are worked during the busy season. The stone is handled with two derricks in the quarry, and one at the railroad yard, in Westport. Adjoining the quarry are the blacksmith shop, office and necessary sheds. The product is principally flagging and curb, together with building stone, that is shipped to the neighboring cities by rail from Westport. The stone is hauled to Westport on wagons.

In the lower Niagara flags, below the marley clay, a single specimen, each, of *Atrypa reticularis*, Linneus, and of *Orthoceras annulatum*, Sowerby, were found. Fossils are abundant in the Hudson River group shales that are seen below the Niagara and Clinton, and the same succession of buff and blue shale seen as at Rossburg.

*Section at Boicourt Brothers' Quarry, Sand Creek Township.*

Southeast of southeast, section 32, township 9, range 9.

Covered space .....	00 ft.	00 in.
Dimension and flag in the bluff, Niagara group....	12	00
Bridge stone with chert nodules.....	3	6
Dimension stone or flag.....	00	5
Dimension stone or flag.....	00	5
Dimension stone or flag.....	00	5
Dimension stone or flag.....	00	5
Dimension stone or flag.....	00	6
Flag .....	00	3
Dimension stone.....	00	8
Total.....	18 ft.	7 in.

This quarry is on, or rather in, Painter creek, as stone is taken out from the bottom of the stream, and on the lands of Hugh H. Hindman, of Greensburg. At the time of my visit, the firm was running with seven employes. The product is handled with two derricks and wagons to the railroad at Westport. During the past season they have shipped curbing and flag to Columbus, Indianapolis, Greensburg, and Edinburg.

Indiana. The stone is easily quarried, loose in bedding, and breaks have been made with drills and wedges, seventy-five feet long, and eight feet wide. The strata are very free from vertical seams.

About half a mile down the creek from Boicourt's, the Lower Silurian is seen in the bottom of the stream.

*Section at Z. Boicourt's Quarry, Sand Creek Township.*

Southwest of southeast, section 32, township 9, range 9.

Soil, thin.....	00 ft.	00 in.
Rubble or flag, Niagara group.....	00	4
Rubble or flag.....	00	6
Dimension stone.....	00	8
Dimension stone.....	00	8
Dimension stone.....	00	10
Dimension stone, massive.....	1	3
Dimension stone, irregular in bedding.....	2	00
Dimension stone.....	1	8
Dimension stone, darker blue than that above, and very even in texture.....	1	9
Dimension stone.....	00	9
Bridge stone with flint concretions, two or more heavy ledges, not worked.....	3	00
Dimension and flag, not worked.....	9	00
Total.....	22 ft.	5 in.

Four or five hands were at work with one derrick, blacksmith shop and a full line of drills, hammers, wedges and other tools. The local demand for foundation stone takes a part of the output, but the principal product is hauled to Westport and shipped by rail.

In connection with the quarry Mr. Boicourt runs a limekiln, in which the weathered top ledges are burned, making a lime that is in good repute with masons and plasterers.

As this quarry is worked back into the bluff the thickness of the available stone will reach more than twenty-five feet. On the south, near by, Mr. Geo. Boicourt has done some quarrying, sufficient to show that good stone can be had. At this

latter place the upper beds are a little more shelly and mixed with chert than the average, but this is probably local and would, in the main, disappear as the quarry is opened up.

Across Sand creek, at the foot of the mill dam above these quarries, a persistent stone, ten inches thick, outcrops, that is referred to the Clinton group. Overlying the Clinton is a bed of marl twelve inches thick, very much resembling that seen at the quarry of Larkin Waters', in Fugit township. Under the Clinton are found the dark-colored shales of the Hudson River group, Lower Silurian, filled with characteristic fossils, but not in a very good state of preservation. Good specimens of *Orthoceras annulatum*, Sowerby, *O. Crebescens*, Hall, and *Atrypa reticularis*, Linn., were found in the Niagara group limestone.

Mr. A. Layton, northwest of northwest section, 21, township 9, range 9, has opened a quarry in the west bluff of Sand creek, two and a half miles southeast of Letts' Corner. In quality the stone is equal to that of the sections already given. The product is sold in the quarry to supply the home demand.

*Section at Greensburg Limestone Company's Quarry.*

Harris City, Sand Creek township.

Earth, gravel and clay.....	8 ft.	00 in.
Rough, eroded stone.....	4	2
Dimension stone.....	1	2
Dimension stone.....	1	00
Dimension stone.....	1	00
Dimension stone.....	1	4
Dimension stone.....	1	6
Dimension stone.....	1	2
Dimension stone.....	00	8
Dimension stone.....	2	00
Dimension stone.....	3	4
Dimension bridge stone, with small chert concretions.....	2	00
Dimension bridge stone, small chert concretions...	1	6
Dimension stone.....	00	10
Dimension stone.....	1	00
Dimension stone.....	1	00

Dimension stone.....	00 ft.	6 in.
Dimension stone.....	00	4
Dimension stone.....	00	7
Dimension stone.....	00	5
Dimension stone.....	1	9
Dimension stone.....	00	6
Dimension stone.....	1	2
Total.....	36 ft.	11 in.

Deducting from the above section eight feet of earth and four feet two inches of rough stone, and there is left twenty-four feet and nine inches of good, merchantable dimension stone. Some of these strata are very heavy and massive in bedding, equaling those of any other outcrop seen in the county. All the ledges are very uniform in texture and color, and free from chert or flint concretions, except as indicated above. The chert in these ledges does not detract from the value of the stone for bridge building. The measurements above given were furnished by Mr. Harris, Superintendent of the quarry.

In order that all that is known, bearing on the value of the stone under discussion, may be presented in one connected history, the following is reproduced from Geological Survey of Indiana, 1878, page 90:

“According to General Gilmore, a cubic foot will weigh 169.98 pounds; crushing strength of a cubic inch, 16,875 pounds; ratio of absorption, 1 to 117.”

## ANALYSIS.

	<i>Per Cent.</i>
Moisture, dried at 212° Fahr.....	0.85
Insoluble silicates.....	5.90
Ferric oxide.....	2.50
Alumina.....	3.70
Lime (equal 74.2 per cent. of carbonate of lime).....	41.55
Magnesia.....	4.93
Sulphuric acid.....	0.90
Carbonic acid.....	38.07
Chloride of alkalies.....	1.60
Total.....	100.00



This stone showed the greatest resistance to a crushing force of any of the twenty-seven specimens tested by General Gilmore, and, according to the experiments of Mr. Thomas H. Johnson, M. A., C. E., reported in *Indiana Geology and Natural History*, 1881, page 34, *et seq.*, the modulus of elasticity of a sawed specimen is put at 6,800,000, which is higher than that of any other stone tested by Mr. Johnson. "In estimating the crushing weight of the stones tested for the State House Commissioners by General Q. A. Gilmore, they were all found greatly in excess of what is required, but it must be remembered that these results are for the ultimate crushing of the stone, while many will commence to yield to somewhat less than half the weight required for their total destruction"—(Cox, *id.*). From the above data the practical strength of Greensburg Limestone Company's stone may be estimated by taking one-half of 16,875 (say 8,000 pounds, in even numbers) in estimating the crushing strength of one cubic inch; this, multiplied by 144, gives 1,152,000 as the weight one cubic foot will successfully resist; or, estimated by another formula, 16,875 pounds, multiplied by 144, and the product reduced by dividing by eight, instead of two, the result is 178,750 pounds as the resisting power of a cubic foot. It is said that the piers that support the dome of St. Paul, London, and St. Peters, Rome, respectively sustain a weight of 39,000 and 33,000 pounds to the square foot. From this it is seen that, tested by the severest formula yet proposed for estimating the strength of stone, the Harris City limestone will safely resist four times the weight of the dome of St. Paul, and a column might be erected from it more than 1,050 feet high before the lower courses would be in danger of crushing—nearly twice the height of the famous pyramid of Cheops.

Harris City is a village of about 300 inhabitants, all of whom derive their support from the quarry. The town is located on the company's premises, and has a hotel, stores, large blacksmith shop, and neat residences, to which the company will soon add thirty more, for the accommodation of their employes.

The stone yards and quarry are under the efficient superintendence of Mr. Harris, who has arranged and erected a splendid system of derricks and cranes, and the machinery necessary

to operate them. Over 100 hands were at work, but this does not represent the company's capacity to quarry and handle stone, when supplemented, as it is, by machinery, steam, and horse power. Seven derricks and cranes were in use, and the machinery partly in place to operate two more cranes. The cranes in process of erection are to complete a circle of four, with a railroad track around the outside, and a central round house for the spools, where one man, with levers and breaks, can control and operate the hoisting and lowering of four cranes. At present, two mules furnish the necessary motive power, but, on completion of the works, are to be replaced by steam. Connected with the quarry is a steam engine and stone crusher, for preparing ballast, pikeing, and material for concrete foundations, and a steam pump, with a capacity to throw 3,000 gallons of water per minute. The crusher is operated only during the leisure season, to work up the broken stone that accumulates on the yard. Another season, it is the intention to increase the capacity to furnish cut stone by putting in three planers. Of course, in a quarry devoid of vertical seams, a channeler is necessary to start a break. The company is using a hand machine that has been improved by the superintendent, and, it is claimed, dollar for dollar expended in operating it, will do more work than any steam channeler.

During the first eight months of the year 1882, 2,500 car loads of stone, an average of over twelve a day, were shipped to the towns and cities of this and the four adjoining States. These shipments but imperfectly represent the value of the product of the quarry, as one car may be loaded with rubble at \$7.50, and another with cut stone worth over \$50. All branches of the trade, stripping, drilling, hoisting, draining, loading cars, cutting stone, and receiving orders by telephone, were in operation, altogether presenting the most active business prospect seen in the county.

The Lower Niagara group shale and flag underlies the section last given, and is known to the quarrymen as the "soapstone" beds. Its thickness I place at eight feet, which is a little more than the average, but not too high for this point. Eight feet added to the Harris City measurement, twenty-eight feet eleven inches, gives thirty-six feet eleven inches as the total thickness

of the Niagara. At the south end of the company's premises, in the east bank of Muddy Fork, is seen an outcrop of the lower flags, thin and of a greenish color. About one mile farther down the valley, in the bed of Sand creek, at Parker's mill, the Clinton group and Lower Silurian are the surface rocks. Both formations are fossiliferous, especially the latter.

*Section at Hart & Bonner's Quarry, Washington Township.*

Southwest of northeast, section 23, township 10, range 9.

Thin soil.....	00 ft.	00 in.
Rubble and flag, cherty in lower part.....	5	00
Dimension stone.....	00	8
Dimension stone.....	00	8
Dimension stone.....	00	7
Dimension stone.....	00	5
Dimension stone.....	00	6
Dimension stone.....	00	9
Dimension stone.....	00	7
Dimension stone.....	1	00
To the bed of the creek, not measured.....	00	00
Total.....	10 ft.	2 in.

Judging from the locality, about half way from the Greensburg cemetery, the top of the Niagara group and the Harris City quarry, where the base of the Niagara is reached, and the lithological appearance of the stone, the probability is that this quarry represents the top members of the formation. The outcrop showed irregularity in bedding. With more system in working the quarry, better results might be had.

*Section at A. Forsyth's Quarry, Greensburg, Ind.*

Town Fork of Sand creek.

Covered space.....	00 ft.	00 in.
Corniferous limestone, lower member, bedding thin, irregular and shelly.....	10	00
Place of the Upper Niagara, Waldron shale.....	00	00
Niagara limestone, irregular in bedding, thin and cherty.....	4	00
Total.....	14 ft.	00 in.

The Niagara limestone at this point is an outcrop of the extreme upper beds, and, as is the case elsewhere, is found in thin strata, mixed with more or less flint nodules and bands. It is quarried for light foundation and rubble. Just north of the Decatur county cemetery, Mr. Forsyth has a limekiln, in which the shelly, Corniferous stone is calcined. The stone used in making lime is intermediate in character, between the soft magnesian Corniferous, used in the Eck kiln, at Adams, and the hard Niagara limestone used in the Scanlan kiln, at St. Paul, and produces a lime intermediate in character, between the "cool" lime of the former and the "hot" lime of the latter. The product of the kiln is in repute with masons and plasterers, and finds a ready market.

At the bridge west of Greensburg, where the Greensburg and Columbus pike crosses the Muddy Fork of Sand creek, there is an outcrop of the Lower Corniferous group limestone, similar in character to that seen at the Forsyth quarry. The exposure has a thickness of about ten feet, and the top ledges are intermediate in hardness, and break into fragments with thin, feather edges; the lower ledges are softer, more even in bedding, and break into angular blocks. This stone was formerly burnt into lime, but the kilns are now abandoned.

*Section on Clifty Creek, Clinton Township.*

Bridge of the V., G. & R. Railroad.

Covered space .....	00 ft.	00 in.
Lower Corniferous limestone, one stratum.....	1	5
Calcareous shale, Waldron beds, Niagara group, weathered to a light buff clay.....	3	00
Niagara limestone, in ledges from four inches to fifteen inches thick, irregular in bedding, in places tight bedded.....	10	00
Covered to bottom of the creek.....	10	00
Total.....	24 ft.	5 in.

The stone for the abutments of the V., G. & R. Railroad was quarried from this place, and as the quarrymen were looking only to getting an immediate supply of stone, the exposure

does not show to the best advantage. In the Waldron shale, or rather clay, fragments of *Eucalyptocrinus caelatus*, Hall, and a few little brachiopods were found, sufficient to identify the formation as the Upper Niagara calcareous fossil bed. Just below the Douglas hole, southeast of northwest, section 12, township 11, range 10, is a bold outcrop of the Niagara in the Clifty creek bank, that has been quarried a little to supply the local demand for stone. The ledges are thin and mixed with chert; farther back, in the bluff, the character of the stone will doubtless improve. Fair specimens of quarry stone were seen in the creek bed above the Douglas hole. The outcrops at these points are about twelve feet thick.

*Section at Mrs. Catherine Hays' Quarry, Adams Township.*

Northwest of southeast, section 32, township 12, range 9.

Rubble, Niagara group.....	00 ft.	00 in.
Shelly limestone, with chert nodules.....	1	4
Dimension stone.....	00	8
Flag or fence base.....	00	3
Flag.....	00	2
Flag or fence base.....	00	4
Flag or fence base.....	00	4
Dimension stone.....	00	8
Dimension stone.....	00	8
Dimension stone.....	00	5
Dimension stone.....	00	5
To the bottom of Flat Rock.....	2	2
Total.....	7 ft.	3 in.

Here the outcrop, on the first bottom of the river, is exposed in mounds and beds, through and around which the river has, at some day, run and cut away a portion of the stone, the whole presenting an appearance not seen elsewhere. The quarry is worked to supply the home demand for foundation stone, and fence posts or bases. By fence bases, must be understood a triangular stone, about three feet long, and from three to four inches thick, that is sunk in the ground, and a wooden fence post fastened to it with an iron stirrup, or link. This arrange-

ment makes a fence in which all the wooden parts are above the ground, and protected from earth-rot. It makes a durable and popular fence; and, as the farmers are using it largely, the demand for bases is increasing yearly. By this invention a new industry is opened up to the quarrymen. The bases are sold, in the quarry, at from twelve to fourteen cents each. The stone at Mrs. Hays' quarry, and that of Mr. Wesley Garrett, just below, on the river, is well adapted, and largely used, for making fence bases.

*Section at L. A. Shellhorn's Quarry, Adams Township.*

Southwest, section 5, township 11, range 9.

Soil and covered space.....	00 ft.	3 in.
Flag or fence base, Niagara group.....	00	00
Flag or fence base.....	00	4
Flag or fence base.....	00	4
Flag or fence base.....	00	5
Flag or fence base.....	00	4
Flag or fence base.....	00	3
Flag.....	00	5
Flag or fence base.....	00	4
Flag or fence base.....	00	4
Flag or fence base.....	00	3
Flag or fence base.....	00	4
Flag or fence base.....	00	5
Dimension stone.....	00	6
Dimension stone, not measured to bottom of creek.	3	00
Total.....	7 ft.	4 in.

The flagging of Mr. Shellhorn's quarry is peculiarly adapted for making fence bases, and is extensively used for that purpose. A stone to work into bases, with but little waste, must be uniform in texture, so it may be broken to the required shape. Judging from the bases seen in the quarry, but little other stone is taken out. Good dimension stone can be had if wanted. If a shipping demand for bases should grow up, as seems probable, this quarry could furnish an unlimited supply. The stone here, on Little Flat Rock creek, and north, on Flat

Rock river, is exposed in the bed of the streams and bends where the superincumbent stone has been eroded away, and probably belongs to middle and lower division of the Niagara group. This supposition is strengthened by the finding of Lower Silurian fossils, at the foot of a hole near the Picayune Mills, that the creek has excavated, thirty feet deep, down to the Hudson River group.

The following extract, giving an account of Mr. W. W. Lowe's quarry, is taken from Prof. Collett's Report on the Geology of Shelby County, published in 1881, and is here inserted that persons interested in the geology of Decatur county may have a full history of what is known to date.

"The quarry of W. W. Lowe & Co., a short distance north-east of the village of St. Paul, is in Decatur county, but shipments are made from St. Paul. They employ, during the summer months, fifty to eighty men, have seven derricks and a full complement of drills and other tools. The opening shows a limestone face of 1,200 feet. They furnish dimension stone for foundations, piers, steps, lintels, sills, etc., and flags and curbs for sidewalks. The chief markets are at Indianapolis, Cincinnati, Terre Haute and Chicago, where it rivals the Joliet stone. The demand for flag and curb stone is extensive, and the supply inexhaustible. The dimension stones are very generally used in Ohio and Indiana for jails.

*Section in Lowe's Quarry.*

Chert and slope, Niagara.....	2 ft.	00 in.
Rubble, four to eight inch bed.....	12	00
"Milk Trough" ledge.....	1	8
Flag.....	00	4
White dimension stone.....	1	00
White dimension stone.....	00	9
White dimension stone.....	2	00
White dimension stone.....	1	00
White dimension stone.....	00	11
White dimension stone.....	1	2
Flag.....	00	5
Light gray dimension stone.....	1	6
Light gray dimension stone.....	3	4

Flag.....	00 ft.	7 in.
Dark blue limestone.....	1	8
Blue laminated—splits to flags; eight feet below bed of river.....	1	6
Total .....	29 ft.	10 in.

According to General Gilmore's experiments for the State House Commissioners, one cubic foot of the whitish gray, close-grained stone, will weigh 168.09 pounds; crushing strength of a cubic inch, 16,000; ratio of absorption, 1 to 336. The following is the analysis published in Geological Survey of Indiana, 1878, page 91:

## ANALYSIS.

	<i>Per Cent.</i>
Water, dried at 212° F.....	0.60
Insoluble silicates.....	5.10
Ferric oxide.....	1.00
Alumina.....	2.40
Lime (equals carbonate of lime, 82.71).....	46.42
Magnesia.....	3.00
Carbonic acid.....	39.78
Sulphuric acid.....	0.80
Chloride of alkalies.....	0.50
Loss and undetermined.....	0.40
Total.....	100.00

This analysis shows a greater per cent. of carbonate of lime than the Harris City stone, otherwise the two are very much alike. The Lowe & Co. stone shows the lowest ratio of absorption—that is, it will absorb the least water.

Messrs. Lowe & Co. have erected a number of neat cottages on their premises for the accommodation of those employed in the quarry, and, with blacksmith shop, office and telephone, presents the appearance of a smart village. At the time of my visit the company were getting out stone to fill an order for jail flagging.

The following section is introduced to show the relation of the Niagara group to the overlying Corniferous stone of the Devonian age, in the northeast portion of the county.



*Section at Railroad Crossing Over Flat Rock River, East St. Paul,  
Adams Township.*

Soil, Drift clay and gravel.....	00 ft.	00 in.
Corniferous limestone, lower. division.....	2	00
Waldron shale fossil bed, Niagara group, weathered .....	6	00
Rubble and flag mixed with chert, some of the strata five and six inches thick.....	15	00
Dimension stone.....	2	6
Dimension stone.....	2	6
Dimension stone.....	2	6
Dimension stone.....	2	00
Dimension stone.....	3	00
Total .....	35 ft.	6 in.

It is an interesting question, how much lower the quarry-stone may reach on Flat Rock than is indicated by the sections given above. The "blue, laminated" (stone) that "splits to flags, eight feet below the bed of the river," of Prof. Collett's section, in the Lowe quarry, has all the characters of the Lower Niagara flags and shale, and I think this will be found to be the geological horizon of this bed. If my supposition is correct, no very valuable stone will be found below the "blue, laminated" stone, and six or eight feet lower, would reach the Lower Silurian.

The principal locality for Waldron shale fossils, is on Mill creek, east of Floyd's mill, and would be visited more than it is by collectors if other good localities were not close by, in Shelby county.

*Section at Milford Bridge, Clifty Creek, Clay Township.*

Corniferous limestone, lower division weathered to wedge-shaped pieces.....	7 ft.	00 in.
Calcareous, Waldron shale, fossiliferous, weathered to a light-buff, Niagara group.....	1	1
Rubble, irregular in bedding, Niagara group.....	00	5
Rubble, irregular in bedding, and cherty.....	00	3
Rubble, irregular in bedding.....	00	3
Rubble, irregular in bedding.....	00	4

Rubble, irregular in bedding.....	1 ft.	3 in.
Dimension stone, irregular in bedding.....	00	9
Dimension stone, irregular in bedding.....	1	2
Dimension stone, irregular in bedding.....	2	00
To bottom of Clifty creek.....	1	3
Total.....	15 ft.	9 in.

It is said that a very superior stone was taken from the bed of the creek near where the above section was made, several years ago, by Prof. R. T. Brown, who exhibited the specimen at the Indiana State Fair, where it attracted attention as the premium stone. If the same rule applies here that does at St. Paul, fifteen feet of the top members of the Niagara limestone, as seen above, will be found irregular in bedding and more or less mixed with chert, and the best stone at a lower level. A few yards below the Milford bridge the lower division of the Corniferous limestone is exposed in an abrupt bluff, more than thirty feet high, and bold escarpments of the stone are the rule in the creek bank below the town.

*Section at C., H. & G. Railroad Bridge, Clifty Creek, Clay Township.*

Slope covered, estimated.....	20 ft.	00 in.
Corniferous limestone, lower division, weathered to a rotten stone of sandy appearance, fossiliferous.....	4	00
Corniferous limestone, with calcite nodules.....	1	5
Corniferous limestone, no fossils, heavy bedded....	2	5
Calcareous, Niagara group, Waldron shale, no fossils.....	3	00
Bridge stone, cherty, Niagara group.....	1	8
Bridge stone, cherty.....	1	6
Bridge stone, cherty.....	0	10
Bridge stone, cherty.....	2	00
Bridge stone, cherty.....	1	10
Niagara limestone, cherty to bed of creek.....	7	6
Total.....	46 ft.	2 in.

The Corniferous group stone at this place presents a very characteristic appearance for all of the Clifty creek outcrops and the whole of Clay township. The quarrymen insisted that it was a sandstone. Not a fossil was found in the shale, nor could anything but fragments be found in the outcrop seen in the ravine east of the quarry. The Niagara stone is tolerably even bedded, but close and difficult to get out in regular blocks. Like all the top members of the group in this vicinity on Clifty creek, it is more or less cherty, but is a very good heavy stone for bridge and similar work. Better stone can be found under the bed of the creek.

*Section at Mrs. Eva Eck's Lime Kiln, Adams, Clay Township.*

Soil and covered space, thin.....	00 ft.	00 in.
Buff magnesian limestone, lower division of the Corniferous group, in ledges from four to fifteen inches thick, fossiliferous.....	10	00
Darker colored magnesian stone, in similar ledges.....	4	00
To bed of Clifty creek.....	4	00
Niagara group, in the creek.....	00	00
Total.....	18 ft.	00 in.

The stone from this quarry is burned to lime in a "perpetual kiln" of 300 bushels capacity, per day, and makes a white, "cool" lime that finds a very ready sale.

The Niagara group limestone has been quarried, some little, from the bed of Clifty, near the town of Adams, but not in quantities to show the quality of the stone.

In the northwest part of Jackson township, on Fall Fork and Middle Fork creeks, there is an outcrop, in considerable force, of massive, heavy bedded, magnesian stone, lower division of the Corniferous group. In places on Middle Fork, the Corniferous is cherty, and, just west of the county line, silicious masses of corals and bryozoa, a variety of "buhrstone," are found. Heavy outcrops of Lower Corniferous were also seen in the bed and banks of Wyalosing creek, due west of Westport.

## QUARTERNARY AGE.

## DRIFT PERIOD.

From the close of the Corniferous to the Drift period, many pages of the geological record are wanting. What the condition of the country embraced in Decatur county was, during these long ages, is mere speculation, more than that it was dry land, subject to all the vicissitudes of climate that prevail at this day. It is reasonable to suppose that the rains, alternations of heat and cold, and other atmospheric influences, were slowly wearing away the rocky face of the land and cutting primitive valleys, that have grown, under more modern forces, to their present proportions, and it is not presuming too much to say that the valley of the Great Miami and the Collett Glacial River valley had a pre-glacial existence. Their extent was greatly increased during the Drift period, and is gradually increasing and changing shape at this day.

Except a little *recent* earth on the creeks and over the low lands, that were swamps until drained, all the complex material of loose stones, pebbles, gravel, sand and clay, found overlying the native bed rocks of the county, is of drift origin, and belongs to the Drift period. That the Drift material is not a confused mixture, like the dump of a quarry, but arranged in some sort of order, is manifest to the most careless observer. Every one who has passed over the county has noted the difference in the appearance and composition of the white clay lands of the "flat woods," and the yellow clay and gravel soil on the west, and the varying proportions in which these latter are combined, and their relations the one to the other. A typical section of the Drift, showing the general relations, was seen and measured in a well, near the county line, in the neighborhood of Hartsville. These actual measurements represent an ideal section of the various layers of clay and gravel considered in orderly succession.

*Section in James T. Galbraith's Well.*

Soil, mixed with very little gravel.....	2 ft.	00 in.
Yellow clay, with gravel and small angular bowlders .....	15	00
Black carbonaceous soil, with timber.....	2	00
Blue bowlder clay, mixed with gravel near the top, and very tenacious and plastic at the bottom.....	5	00
Corniferous group limestone .....	4	00
Total.....	26	00

Of course, it is not to be expected that every well in the county, that even reaches down to the bed rock, will show all the four strata seen in Mr. Galbraith's well some one or more may be wanting, but the order in which they occur is never changed; blue bowlder clay never overlies yellow clay.

*The blue bowlder clay* is the most generally present of any member of the Drift series, and covers the bed rocks of the whole county, except where it has been removed by the action of forces that have operated since the close of the first chapter in the history of the Drift period. It is exposed in the bluff banks of Fall Fork, Middle Fork and Dry Fork creeks, where the overlying yellow clay and gravel are thin in the north part of Jackson and south part of Clay townships, and in the vicinity of Westport. The blue bowlder clay, weathered and altered in appearance by exposure to atmospheric influences, is the surface soil of the "flat woods." The western boundary of the white clay lands of the "flat woods," may be roughly indicated by a line drawn from the east of Clarksburg, to the head of Cobb's Fork of Sand creek, thence south with Cobb's Fork to the vicinity of Westport. All of the county east and south of this boundary line is blue bowlder clay changed to a grayish white and less retentive of moisture. I am aware that the white clay of Southeastern Indiana, especially of Jefferson and Jennings counties has been referred to another epoch than the Glacial, but, to my mind, the proof is satisfactory of the identity of the *blue clay*, found under the yellow clay and gravel all over the county, and the surface *white clay* of the "flat woods," so far as concern Decatur county; and I come to this conclusion without raising the question as to what may be the

case elsewhere. In riding from Kingston to Mechanicsburg, with Mr. T. L. Donnell, he said: "Between here and Mechanicsburg I will show you where you can stand with one foot on land as poor as Lazarus, and the other on land as good as any in the State." On reaching the place indicated, the sharp line of juncture was marked by a low ridge of yellow clay and gravel, that could be traced with the eye for nearly a mile in each direction. *This ridge rests on the so-called white clay;* and the language of Mr. Donnell is quoted to show that this, being the case, is a matter of common observation. West of Westport, in a shallow valley, the road has cut through fifteen inches of yellow clay and gravel, and three or more feet of blue clay; a short distance east the gravelly layer is wholly wanting. The blue and white clays are identical in physical make-up, except where gravel has been added by the same forces that covered it with yellow clay, and in chemical composition they are the same, under similar conditions. The boulder clay is of much more frequent occurrence in the east part of Bartholomew county, than is indicated by my report on that county, *Indiana Geology and Natural History, 1881.* It is made up of sand, gravel, pebbles and clay, mixed with bowlders of northern origin. In proportion to the whole mass, the clay largely exceeds all the other materials. Where protected by the yellow clay its color is blue or drab, where exposed, weathered to a grayish white. The difference in color is due to the action of the oxygen of the air on one of its constituents, the oxide of iron. In the "flat woods" the top is free from gravel. In Messrs. T. C. Doles & Brothers' tile pit, near Smith's Crossing, seven or eight feet down in a soft, blue clay, is seen a little gravel, and about twenty per cent. of sand, not enough, however, to prevent its making good tile; and water-washed and worn gravel is generally found in digging wells, from eight to thirty feet below the surface. When covered with yellow clay, and the top has been disturbed, the color is a little lighter blue, and the proportion of gravel increased near the line of juncture, but the true strata may be readily distinguished, the one from the other. The consistency is very different; the blue clay is a uniform, sticky, plastic, wet mass, nearly impervious to water, the equivalent of the "tile" of the English geologist, and when dry a veritable "hard-pan." The yellow clay is easily exca-

vated, wet or dry, and freed from moisture, is very friable. Boulders are seldom found, and never of large size. The only polished and striated stone that I have seen, found in either Decatur or Bartholomew counties, was taken from the blue clay bed of a well. Beds and lenticular masses of sand are not infrequent, and are the water-bearing strata.

*The black soil bed* is generally present where the boulder clay and the yellow clay form a junction. It has never been reported as occurring in or under the blue boulder clay, or its equivalent, the white clay of the "flat woods." Mr. Frank Galbraith, an intelligent observer, who has dug eleven wells in the west part of Clay township, reports the succession to be: soil, yellow clay and gravel, black soil, frequently with buried timber, and blue clay. Mr. Enos Woodruff, in sinking two wells in the north part of Jackson township, reports the same strata. Mr. James Banister, of Alert, has dug four wells and found the black soil in all, and timber in a part of them. Buried timber is generally found in sinking wells about Newburg, on Sand creek, and in the vicinity of Clarksburg. The finding of buried timber several feet below the surface, is a phenomenon so striking to the average mind, that inquiry develops the fact, in all neighborhoods where the yellow clay is not replaced by sand or gravel; and frequent as the finding of timber may be, it is not nearly so often noted as the more frequent occurrence of the black soil. In thickness it ranges from two to eight feet, most usually about two feet. In physical appearance it more nearly resembles the blue boulder clay, and where it has apparently been disturbed, at some time in its history, is mixed with gravel. Its depth below the surface ranges from fifteen to thirty-six feet.

*The yellow clay stratum* is a heterogeneous mixture of clay, sand, gravel, pebbles and boulders, and forms the surface soil or subsoil of the central and western portions of the county. It is not uniform in composition; the relative proportion of its materials vary within a few feet. In general, the clay elements exceed all the others and is much less retentive of moisture than the blue boulder clay, but not so pervious as native clays. The proportion of sand is largely increased over Jackson and Sand Creek township, and locally over the south part of Clay township, where it occasionally replaces the clay down to the

bed rock, and when water bearing, is a quicksand. Beds and ridges of gravel mixed with clay are common, but beds of good road material are only found in the northwest part of Jackson township and in Clay, Adams and Clinton townships. A remarkable bed of gravel, is that on Big Flat Rock river. Commencing just below the confluence of Little Flat Rock creek with the river, it occupies an area one mile wide by three long, on the east bank of Big Flat. It lies in the fork of the streams, except at the lower end, where it is cut across by both the river and the creek. It is said that this bed of gravel, spread out and mixed with yellow clay, reaches into Rush county, and is known as a great wheat growing belt. In Decatur county, the bed in surface appearance and internal make up is identical with the Haw Patch gravel, of Bartholomew county, except that here it is known to rest on the boulder clay, and occupies a higher level above the neighboring streams. The top of the bed is fifteen feet below the general level of the country, and forty-five feet above the bottom of the river. Where cut by the creek and river, it is bounded by bold steep bluffs. Another small bed of gravel of similar, if not identical, appearance is that seen between Middle Fork and Fall Fork creeks, near the county line. An excavation in the bank of one of these latter beds, shows gravel mixed with the soil at the top and finer gravel below until a quicksand is reached, all arranged in tolerably uniform, and nearly horizontal strata, as if deposited under running water. At the foot of the Flat Rock gravel, great quantities of pebbles, rounded and angular boulders, with pieces of limestone derived from the Niagara and Corniferous groups, were seen piled up in a confused mass.

In the southeast quarter of section 8, township 10, range 8, commences an upland, "hogs-back," of gravel, that can be traced in a continuous ridge to the Clifty Creek valley. North of the creek it is continued in gravel hills and ridges beyond the Shelby county line. Its total length is near four miles, and fades into the yellow clay at each end. Its course is a little east of north. At the south end it has the width and much the appearance of a gravel road, and was used as such in the early history of the county. On each side of the ridge the soil is free from gravel, black and swampy. North of Clifty creek, on the farms of Mr. Ed. Marshal and Mr. John P. Elliott, the



ridge is cut into hills or mounds. Two of these mounds were examined where excavations had been made for road material. The stratification lacks the regularity of the Haw Patch or Adams township beds. No two sections, even when taken within a few feet, will represent the same succession of strata and materials. The sand sometimes lies in heavy deposits, several feet thick, the strata running in curved lines and vanishing layers at an angle of several degrees to the horizon. Sudden changes from sand to gravel occur, or the gravel may be replaced by pure sand without signs of stratification. Again, pockets of bowlders are found in such size and quantity as to spoil the gravel for use on the roads. These collections of bowlders are in confused piles, without stratification or other evidence of orderly arrangement. The whole mixture below the surface soil is free from clay, and shows the stratification most, if at all, where the gravel is of medium size. The layers are thin, ranging from one to five inches, and seldom reaching the last figure. The largest per cent. of the materials in the upland beds and mixed with the yellow clay is metamorphic sand, gravel and bowlders, derived from the Huronian and Laurentian hills north of the great lakes; the remainder is made up of chert and hard fragments weathered from the Niagara and Corniferous limestones. Especially are the Corniferous group corals common. It is very probable that a large per cent. of these corals are of Canadian origin.

*The yellow clay bowlders* are much more frequently found than those of the blue clay; they are of larger size, less worn and more angular. Representatives are found, of nearly all the primitive rocks; the most common are varieties of granite, gneiss, mica schist, greenstone, hornblende and diorite. They are most numerous along the west boundary line of the county, where they lie on the surface, or but partially buried in the soil. East and south of Clay and Adams townships, large bowlders are rare.

*Yellow sand or moulders' sand* in beds, have not been seen, but banks of washed sand on the creeks are common. Lenticular beds are found in digging wells in the yellow clay, and are frequently water-bearing.

In thickness the yellow clay is heaviest in Washington, Clinton and Adams townships, where the average is about twenty-

five feet; in the south part of Clay, and over the whole of Jackson townships it grows thinner, and the per cent. of gravel is gradually diminished and the sand increased.

*The soil* of Decatur county is mainly of foreign origin, that is not due to the disintegration of the native stones and shales, and is largely modified by the blue boulder or yellow clay on which it rests. The close of the Drift period left a barren waste of dry land, that time, "the avenger of all things," through the influence of climate, air, water and other forces, has brought to its present state of fertility. That plants and animals have been important factors in forming a soil over the clay beds, has been pointed out by Prof. Wm. Orton, and especially have the influences of earth-worms been studied and described by the late Mr. Charles Darwin. The work of the ant, crawfish and burrowing beetles, was supplemented and protected from the wash of the rains, as soon as the clay was covered by vegetation, however scanty it may have been; and in the case of the yellow clay, this must have been very soon, judging from what is seen when the subsoil is now exposed, and plants at once take root and grow. Doubtless these insignificant workers and the plants, brought to the surface clay and the soluble, chemical compounds, and left the pebbles and coarse sand below; hence, in time, a clay or loam soil, free from gravel. Taking this view of their work, the much despised earthworms and crawfish, as benefactors of the race, deserve more consideration at the hands of man, than to be ruthlessly murdered for fish bait. The low, black, burr oak soil of Clay and Jackson townships, and to a still more limited extent of other townships, was formed under swamps, and has been increased by the wash and sediment of the water that has flowed over it. Over the pure gravel beds, it is probable that the soil was mainly formed through the instrumentality of plants, and the result is a soil of the greatest fertility, with but a slight admixture of clay. The white clay soil of the "flat woods," the black, burr oak soil, and, in fact, all soils of the county, just in proportion as the clay exceeds the gravel, require underdrainage; except on the swampy lands, the amount of the subsoil mixed with the surface, determines the character and appearance of the soil.

## RECENT PERIOD.

This period includes all the various sediments of running water, earth, sand and gravel, that are known as alluvial deposits, and forming at the present day. In consequence of the absence of important water courses the deposit forms but a moiety of the clay or earth of Decatur county, and is here referred to only to complete the history. Attention is invited to the fact that the increased facilities for the drainage of the country renders the streams more liable to overflows, and consequently greater modification of existing deposits than was formerly the case.

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ECONOMIC GEOLOGY.

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## AGRICULTURE.

The yellow clay soils have in them untold possibilities. I was shown a productive field on Little Flat Rock creek that had been planted to corn for fifty years, without change or rest, until last year. The crop reports for 1882 show that Decatur is one of the three largest corn-growing counties south of Central Indiana, and well up in all the other farm products. An exhausted yellow clay soil can be readily brought back to fertility, and fertilizers yield a big profit on the investment. The sub-soil contains all the chemical elements of fertility, and once brought to the surface is within itself productive, hence this kind of a soil never can be wholly exhausted.

The white clay soil of the weathered bowlder clay, is too close and compact to be a very certain soil in all seasons, wet or dry, without extensive artificial drainage. These lands have been occupied principally by thrifty Germans, and it is astonishing what they already have accomplished in the way of farming. Once thoroughly drained, this soil produces excellent crops of wheat, corn and grass.

## BUILDING STONE.

The vast importance of the quarry interest, and its bearing on the present and future wealth of Decatur county, can not be overestimated. I have already attempted to show its magnitude at this day, and its potentialities for the future. No county in the State can compare in the amount of Niagara limestone exposed, the ease with which it can be quarried, its strength and uniformity of texture. The supply is inexhaustible; thousands of acres of merchantable stone twenty-five feet thick, covered only with a thin soil, await development against the eighteen or twenty acres that have been removed. The demand is for all kinds of stone for architectural use, from the foundation to the coping, and for heavy masonry can not be superceded. At present the supply and demand are equal, and no stone is left over in the yards. Orders that can not be filled with available stone, without much stripping, are sent to other firms, and the ledges in sight disposed of first. The stone comes from the quarry with the top and bed ready for use, and in consequence of the absence of vertical seams or faults, can be had in length and width far beyond the possibilities of transportation.

## LIME.

The buff magnesian limestone of the lower division of the Corniferous group, within the last few years, has attracted attention as a lime rock. Its very appearance was against it, and caused it to be passed by until tested, when it was found to make a beautiful white lime, that is rapidly growing in favor with masons and plasterers. At Greensburg, the locally harder portion of the bed is burned; at Adams, the softer, spongy stone. All the members of the Corniferous group below the North Vernon stone, make what is known as "lean," or "cool," lime. This is due to the stone containing a greater per cent. of magnesia and alumina than the Niagara limestone, that produces a "fat," or "hot," lime, that slacks quickly. The "cool" lime slacks slowly, runs smoothly under the trowel, and does not "chip-crack," like most of the "hot" lime plastering. When used in mortar it partakes more of the character of a hydraulic cement than the "hot" lime, and in time becomes

harder than brick. The Niagara limestone makes a first-class, strong lime, and for certain purposes, as purifying gas, can not be superceded. Decatur county has an abundance of stone, easy of access for the manufacturer, of either variety.

#### BRICK AND TILE.

The weathered white clay of the "flat woods," is a first-class brick or tile clay. The principal tile factories that came to my notice were those of Mr. Wm. M. Hamilton, at Clarksburg; Isaac Deilkes, Glidewell & Martin, and J. T. Doles & Brothers, near Smith's Crossing. The Messrs. Doles have the largest factory in the county. They use steam as the motive power, employ eight men, and have a kiln capacity of 18,000 tile. The capacity of the other kilns is about 10,000 at a burn. The product of the factories is sold in the yard. The other surface clays of the county, where free from gravel, and not too calcareous, make the best of tile and brick. In short, the rule is to burn the brick near where wanted, out of the clay found in the vicinity.

#### SAND.

The washed river and creek sand, especially of the west part of the county, is in high repute with builders for all kinds of work. It is said that the clean white sand of Sand creek, east of Greensburg, has been used for making glass in the New Albany factory. With its inexhaustible beds of the very best building stone, unrivaled brick clay, superior limerock and sand, Decatur county is destined in a near day to take rank as the stone, brick and lime "Newcastle" of the Ohio valley.

#### FRUIT.

All the orchard and small fruits are grown. The apple does well on the yellow clay soil for a few years, but seems to be short lived. This trouble might be remedied by more care in selecting varieties that have proved hardy, not only in this latitude, but on *this* soil. It is a well known fact to any person who has paid attention to botany, that certain forest trees are found on a peculiar soil, adapted to their growth. The sugar

maple does best, and is common on a limestone soil or ledge, the sweet gum and persimmon flourish on the compact, impervious clays; and it is reasonable to suppose that the same may be true of the different varieties of the apple. An apple is an apple, but a wild crab is not a Rome beauty. Peaches are too uncertain a crop, except for domestic use. Pears, plums and cherries do well. Grapes have not been tested beyond a home supply; but as the northern fox grape, *Vitis labrusca*, L., grows wild, luxuriantly, on the white clay lands in the neighborhood of Millhousen and Westport, it is more than probable that its cultivated varieties, the Isabella, Catawba, Concord and others could be very successfully grown.

#### WATER SUPPLY.

In sinking wells an uncertain supply of water may be struck in the sand seams of any of the clays. The veins found in the blue clay are the stronger, but are liable to fail in seasons of drought. A certain supply is found a few feet below the surface of the stone in about one-half the wells dug. Springs are not common, and driven wells infrequent. The Niagara shales are generally water-bearing. It is not all water which is "clear as a crystal" and cold that is free from pollution. The greatest safety is in deep wells, sunk where there is no possibility of contamination from surface drainage, or soakage from the barn yard, or other outbuildings. Recent investigations in sanitary science have rendered it very probable, to say the least, that typhoid and the so-called typho-malarial fever have their origin in contaminated drinking water. This being true, typhoid is essentially a preventable disease, and can be prevented by using only potable water for all purposes. No well is safe that does not go into, or rather below, the blue clay.

ARCHÆOLOGY.

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Mr. Geo. H. Dunn, postmaster, Mr. Jos. Davidson and Prof. L. H. Marshall, of Greensburg, have paid special attention to the antiquities of the county, and have made fine collections. Some of their specimens are very rare and can not be duplicated. Professor Marshall, at my request, has prepared the following account of the Indian relics, etc.:

The archæology or antiquities of Decatur county furnish the archæologist or collector of relics a prolific and very interesting field of observation. The earthworks, in the form of mounds, are neither numerous or large, but the surface relics or antiquities, such as stone and flint implements, are abundant.

To locate and describe the most important mounds of this county, time and space prevent, and no correct or adequate conception of the rare antiquities, implements or emblems, can be formed without the aid of cuts or plates. The mounds, so far as my observation extends, are found chiefly along the water-courses which flow through the county, of which Flat Rock and Clifty are the principal ones, evidently showing that such streams were the favorite and necessary places of resort of the pre-historic people. The mounds are principally burial mounds, as skeletons or bones are found in most of them, which crumble readily upon exposure to the atmosphere. And I regret to say, that in the excavation of some of these mounds by our worthy and esteemed fellow-townsmen, Messrs. Geo. H. Dunn and Jas. Davidson, with myself, disclosed the fact that these mounds had been previously disturbed, by unskilled and ignorant curiosity seekers, other than ourselves, as the bones were usually found by us thrown back together in a promiscuous mass, without observing the surroundings or developments made, or even preserving the few relics found therein. That these mounds are artificial, we have abundant and conclusive evidence, as a diversity of soil, stone vaults, shells, coals, ashes, beads, wristlets, also pottery, and fragments of the same, have been found in them, but unfortunately, these last mentioned came into the possession of non-residents of the county.

From a mound on a high, plateau-like tract of land, on the farm of the Shellhorn estate, near the junction of Little with Big Flat Rock, was found by Messrs. Dunn, Davidson and myself, a large and remarkable sea shell (*Busacon perversum*), thirteen inches or more in length, capable of holding probably a half gallon of liquid. The whorl or volutions, running the unusual way, to the left, two small holes, one at each end, are perforated, probably serving the purpose of carrying it, by means of a cord, suspended from the opposite shoulder. This rare specimen forms a part of Mr. Dunn's collection. Of the surface relics, stone axes, chisels, pestles, fleshers, gouges, flint arrows and spear points, have been found rather plentifully; rare slate specimens, such as pipes, emblems, medicine tubes, shuttles, etc., have been found, also one slate axe. All of which no written history has been transmitted to us, to enlighten us as to the use of these mysterious emblems and implements by the people who have long since passed away. Highly polished chisels, a very peculiar gouge, sharp, concave on one side, and convex on the other, and the most perfect canoe-shaped shuttle, with a number of other peculiar and interesting relics, constitute a part of Decatur county antiquities. The arrow and spear points, embracing all the unique forms of flint, quartz and carnelian, are found throughout the county in abundance.

The pestles, axes, fleshers, chisels, gouges, etc., are principally of gray-stone, green-stone and granite. The emblems are chiefly of blue or striped slate (diorite?), very highly polished. In the locality of New Point, I am informed, was found earthworks, evidently once a well-planned town or village, evincing a civilization and intelligence far superior to the modern Indian. Of the more modern Indian antiquities we have but few; perhaps my own cabinet will comprehend nearly all of any importance.

L. H. MARSHALL.

December, 1882.

THANKS.

I am under obligations, and hereby return thanks to all with whom I came in contact in the prosecution of my work. I am under especial obligations for favors and information to Messrs. Geo. H. Dunn, Jo. Davidson, Jos. Drake, S. S. Anderson,



civil engineer, and Prof. L. H. Marshall, of Greensburg. I am indebted to Mr. Anderson for railroad and other elevations, and to Professor Marshall for the foregoing account of the antiquities of the county, which have been kindly furnished "without money and without price." To Mr. T. L. Donnell, of Kingston, whose hospitality I enjoyed for three days, who kindly furnished the conveyance and went with me to places that otherwise I would have been unable to reach; to Mr. C. A. Hamilton and Prof. E. A. Allen, of Kingston; Mr. T. C. Doles, of Smith's Crossing; Mr. John Shellhorn, of Adams township; Mr. Jenkins, druggist, of St. Paul; Mr. Isaac Vansickle, of Hartsville, and to Mr. Geo. K. Greene, of the State Geological Rooms, for identifying and naming the Lower Silurian and Clinton group fossils.



## GEOLOGY OF JAY COUNTY.

By *DAVID S. M'CASLIN.*

### LOCATION AND HISTORY.

Jay county was settled in 1833, and organized as a county in 1836, taking its name from John Jay, first Chief Justice of the United States.

Its eastern boundary is the State of Ohio, having Randolph county on the south, and adjoined to the westward by Delaware and Blackford counties, with Adams on the north.

In area it comprises about four hundred square miles, or nearly 260,000 acres of land.

The population in 1840 was but 3,863. The last census (1880) enumerates 19,281. The rapid increase of the last two years would probably raise the number considerably above 20,000.

In material development Jay county has been very much retarded, owing to no natural disadvantage, but mainly because of her isolation commercially. The intelligence and energy of the citizens has been constantly hampered by the absence of facilities for transportation.

Until within ten or twelve years they have had no connection with the railroad system of the West.

No less than three roads had been projected and partially built many years ago. Some of them were lines of importance, but all were abandoned after much work in grading had been done. It is probable that present enterprise will take possession of two of the old grades, as they are well preserved.

Three railroads now traverse the county. The P. C. St. L. (branch of the Pennsylvania Railroad), crosses the southwest corner of the county, passing through the thriving towns of Redkey and Dunkirk.

The Lake Erie & Western Railroad enters the county at the southwest corner, going northeast to Portland, thence eastward across the centre of the county.

The Grand Rapids and Indiana R. R., passes through the county from north to south, crossing the Lake Erie and Western at Portland.

Portland, the flourishing county seat, is rapidly becoming quite a business centre, having direct communication with Ft. Wayne, Richmond, Toledo and Indianapolis. All branches of trade are well represented, and on every side energy and enterprise manifest, in the erection of large business blocks, factories, elevators, mills and many beautiful residences.

One or two new railroads are now under projection, one being proposed, and the right of way granted, that will penetrate the county from the northwest to the southeast, entering Jay county at Camden, running from Bulffton to Union City. This will give the county a perfect net-work of railroads, and their number will atone for the isolation of the past, in which of necessity the vast resources of this county were but partially developed.

These are now opened up, and energy and enterprise are quickened and stimulated on every hand, giving promise of future prosperity that will make Jay the peer of any county in Indiana. It now possesses all the elements of commercial progress, an intelligent, hopeful citizenship, a soil of great fertility, and railroad connection with the great trade centers.

#### SURFACE FEATURES.

Generally speaking, Jay county is a portion of the north-western slope of the great water-shed lying between the Ohio river and the great lakes.

In surface configuration it is quite similar to the remainder of this great plateau region; especially is there a similarity of appearance with the localities eastward in Ohio, bearing the same relation to the great water-shed.

The Ohio counties adjoining to the east all have the gently rolling and undulating surface that characterizes Jay county.

The drainage of the county is mainly to the northwest, though the high ridge traversing the southern portion of the

county forms a water-shed, sending a number of small streams southward to the Mississinewa, and eastward to the headwaters of the Wabash in Ohio. The streams are all quite small, the Salamonie being the largest.

The Wabash barely touches the county at the northeast corner, flowing off to the northwest through Adams county. As a rule the streams have shallow channels, flowing with sluggish currents through level alluvial valleys. In certain localities, however, they have excavated deep channels through barriers of bowlder clay, presenting rocky bottoms flanked by bluffs with bold escarpment.

The whole central part of the county is a broad plain, of very level alluvial land, underlaid locally with unstratified blue clay, with occasional shallow deposits of sand and gravel. Fine sand exists locally in the clay, though the beds are irregular and not persistent.

Through this broad plain winds the Salamonie, with a general course from southeast to northwest, occupying the geographical centre of the county, comprising more than half of its area, embracing all of Noble, Wayne and Green townships, and including large portions of Penn, Knox and Pike townships. Its tributaries are all small brooks, finding their way from the elevated regions lying southward and northward. In Jackson, Bear Creek, and Wabash townships, the streams are all tributaries to the Wabash, the three largest being Wolf creek, Bear creek and Limber Lost.

The great central plain of the county is flanked on the south by an elevated ridge extending east and west across nearly the whole southern part of the county. It distinctly traverses Madison, Pike and Jefferson townships, gradually sloping off into a level plain in the western part of Jefferson township. It is locally known as the "Lost Mountain." It nowhere approximates to abruptness in appearance, but nevertheless the outline of highest elevation is very perceptible.

The Grand Rapids & Indiana Railroad crosses its summit below Hudson Station, at a grade of seventy-five feet to the mile, and that with a very deep cut into the crest of the ridge.

It is a mighty mass of glacial material, apparently heaped up against the Niagara rocks that crop out in force at Ridgeville.

This morainic material is, on an average, more than one hundred feet thick, reaching in certain localities a possible thickness of two hundred feet.

At New Mt. Pleasant, in Jefferson township, a well was dug to a depth of 108 feet without finding water or reaching the limestone. At other points eastward, deep wells have never passed through the clay, showing that this ridge is not caused by an elevation of the limestone, but that it is a mass of unstratified drift resting upon the Niagara rock.

It appears to be for the most part a mass of heavy boulder clay, with only local and irregular deposits of sand. On the outcrop at Ridgeville the elevation is 993 feet above the sea. Four miles north the railroad crosses the summit at an elevation of 1,053 feet, or 480 feet above Lake Erie. Six miles north of this summit, in the bed of the Salamonie, the limestone appears at an elevation of but 882 feet above the sea, being 111 feet below the level at Ridgeville, and 171 feet below the summit of the ridge. The general dip of the limestone at both points is northward, and the strata are apparently quite equivalent, thus giving the formation a descent of eleven feet to the mile to the north. There being no marked evidence of extensive erosion, we conclude that this extended elevated ridge is a morainic mass resting against the northern slope of the Niagara formation. Considering the position and arrangement of this ridge, the absence of gravel deposits in its mass, and its extension as a ridge of clay entirely across the county, we consider it one of a series of terminal moraines marking the path of the retreating glacier.

Eastward from Hudson Station it becomes gradually higher, and at a point observed in section 21, in Madison township, we judged it to be over 1,100 feet above the sea, and more than 500 feet above Lake Erie. Its surface, generally, is quite unbroken, though the southeast part of Madison township was quite hilly. Over portions of Pike township, large boulders are numerously distributed, most of them crystalline metamorphic rocks. In several places large masses of Devonian limestones were observed full of characteristic fossils.

To the northwest of the plain of the Salamonie lies another great barrier of boulder clay, not so marked in its outline as the southern ridge, yet clearly enough defined to exhibit a marked

parallelism. Its general course is from northwest to southeast, extending as a summit region along a line lying generally a little south of the line of the northern tier of townships, except in the western part, where the eroded valley of the Salamonie alters the outline of surface.

The elevation at no point is as great as that of Southern ridge. The Grand Rapids Railroad crosses it, five miles north of Portland, at an elevation of 955 feet above ocean level or 382 feet above Lake Erie. Localities westward in Penn township, are evidently somewhat higher.

The clays of this region are very thick and heavy. Where they have been undisturbed there is but little sand or gravel. The gravel beds are local deposits, lying invariably above the blue clay, and of later origin.

The great underlying mass in both ridges is an unstratified mass of blue clay, varying little in general characteristics.

The northern ridge gradually slopes off toward the Wabash, its gentle descent giving course to a number of small streams. In the northern part of Jackson township exists a marshy region, locally known as the "Loblolly." It is from one to two miles wide, and is about five miles long. It extends from the Adams county line, in a southwest direction, ending about section 17, Jackson township. Southwest of this point is a succession of ridges of sand and gravel, gradually thinning out toward Camden.

Continuous with the "Loblolly" basin, a broad channel passes through this region of ridges, along the line of "Haines' Ditch," passing southward into Blackford county, through the broad, low prairie lying northwest of Camden, comprising portions of several sections.

The northwest part of Penn township is high and rolling, as is observed in the region of Balbec, in section 15.

From this general survey, the whole surface configuration of Jay county is outlined by the deposition of glacial detritus forming a moraine in the southern part, and a similar, but smaller one in the northern part. The southern one has been subject to no rearrangement of its material, but the northern one has been altered by a subsequent modification in past glacial times, in which the later floods reassorted much of its mass,

covering the clays in places with deposits of sand and gravel, an arrangement not observed anywhere on the Southern ridge.

#### GEOLOGY OF THE DRIFT.

The surface features as just described indicate the characteristic phenomena of the Glacial and Fluvial epochs. Their exhibition is very striking. The arrangement of the clays and gravel beds furnish favorable opportunity for the study of the dynamics of the Great Ice age.

The causes of the Glacial epoch have been discussed fully and ably in many preceding reports. But a few words for the better understanding of what follows by those who have not studied this subject.

The Glacial epoch is a part of the recent period of Geological history. It came on gradually at the close of the Tertiary, a mighty glacier forming in northern latitudes, and as its mass accumulated extended its foot southward, until it terminated finally in the latitude of Cincinnati, its average southern limit being about the 39th parallel of latitude. Various causes are assigned for the formation of such an ice mass. The probability is, that a number of agencies were conjoined in this great work, the most active being the gradual elevation of the region lying northward. Elevation occasions lowered temperature. The evidence for such elevation in this period is convincing.

Deep channels cut in glacial latitudes show such elevation, the depression at the close of the Glacial epoch causing them to fill up with glacial material. The striations on the surface of the rocks in many places show that the great ice mass moved southward with such great volume and depth that it was unhindered in its course by inequalities of surface.

Its weight and motion are the elements giving it great power. Such a mass passing over a rock surface would act as a great plane, tearing up masses of rock, taking them into its own mass, would transfer them to other localities, where its dissolution would deposit them. Our boulders are all these fragmental rocks, none of them being native. Softer material would be ground finer, and in the action of water would distribute itself

in sand bars and gravel beds. The melting of the glacier supplies another agent that acted powerfully in the distribution and arrangement of the drift, namely, great volumes of running water. These sluice-like torrents reassorted and modified many deposits of the glacial detritus, commingling often sand and alluvium preparing the way for future fertility.

In Jay county, the various results of the Glacial period may be satisfactorily studied.

The heavy deposits of unstratified blue clay, its wide belts strewn with bowlders, its ancient channels now filled up, sand and alluvium, all furnish data illustrative of its dynamics.

The whole ridge previously described, known as "Lost Mountain," is a portion of a vast terminal moraine. It is one of a series of such moraines marking the path of the retreating glacier.

The receding glacier as its dissolution went on probably made periodical advances. Each new terminus would make a new moraine. These successive accumulations of detritus would lie as ridges parallel with the southern limit of the glacier. The parallelism of these morainic ridges has been observed in the survey of the western counties of Ohio. They mark periodical resting places of the retreating glacier.

This great ridge is composed entirely of a heavy mass of unstratified boulder clay. There are no deposits of gravel in it.

The ridge forming the water-shed in the northern part of the county is similar in character, and the clays show the same arrangement. Wells have been sunk to a depth of 130 feet, as in section 13, Penn township; in section 32, Jackson township, 80 feet, and at the County Farm, 95 feet. None of these wells passed through the clay. All these points are on a line following the summit approximately. Being nearly centrally located on the water-shed, they all pass through the same heavy clay, and they mark a low morainic ridge quite parallel with the great moraine of "Lost Mountain." Between them lies the broad plain of the Salamonie and its tributaries. It is a depression which fluvial waters did not fill up, though currents of shallow water must have flowed over it in ancient times, partially filling up the great trough between the two morainic masses. It is covered deeply and in wide extent with



alluvial and fluviatile deposits, with local shallow deposits of fine sand and gravel, as seen south of Portland, and, again, in section 5, Noble township, and other points.

The filling up of this valley makes the outline of the moraines less distinct. The city of Portland stands upon a deposit of alluvium, passing through which the blue clay is met locally, but generally the limestone occurs at varying depths.

Over a large portion of Greene and Knox townships this condition prevails. Locally there are patches of white cold clay, probably of sedimentary origin.

Thus the character of the valley now occupied by the Salamonie shows that it was not formed by the excavation of the bowlder clay, but that it originally existed as a valley between two great masses of morainic material, and has been partially filled by fluviatile and lacustrine deposits. In the whole plain of the Salamonie there are no evidences of swift currents, but only of gently flowing streams, leaving shoals of fine sand and shallow gravel beds.

The absence of bowlders from the valley of the Salamonie throughout the eastern and central part of the county also suggests that this plane does not result from erosion, for where that occurs the eroded channel is left with its bed thickly strewn with bowlders. The absence of these sustains the view that the Salamonie has simply chosen its course through a basin between two moraines, which gradually has been filled with fluviatile and organic deposits. These deposits are notable over portions of Noble and Wayne townships.

It is concluded, therefore, that the two heavy clay deposits of the county are two succeeding moraines, and that the present surface configuration of Jay county is outlined by them, though later influences have modified them, introducing new conditions.

These modifications came from surface and mass changes in the moraine itself. The matter composing it naturally solidified, its own weight promoting density, thus lowering its height; and, besides, the action of surface water would also assist in leveling down its summit. Under these influences the outline of a moraine would be modified, and in course of time it would assume the flattened, plateau-like appearance of the "Lost Mountain."

But the most marked changes in morainic material came with the period of greatest recession, when the dissolution of the ice was most rapid, and, consequently, the volume of water greatest and deepest. This produced a great inland fresh-water sea of mighty extent. There is evidence that the elevated water-shed of Ohio and Indiana was at least partially under water during this period. (*Vide* Ohio Survey, Vol. II, p. 47.) This time preceded the establishment of the present system of drainage for the lake region, the waters in that time finding outlets toward the Ohio and Mississippi. The abounding waters found passage-ways through the accumulated ridges of detritus and over the barriers of rock, making sluice-ways that are still distinctly outlined, though many are partially filled up with alluvial deposits.

These superfluous floods are found to have cut their way over summits ranging from 350 to 400 feet above Lake Erie. Newberry mentions five of these ancient channels passing over the present water-sheds, at an average elevation above Lake Erie of about 350 feet. The nearest one of these channels to Indiana is the one passing over the St. Mary's summit, at an elevation of 367 feet above the Lake. It connects the valleys of the Maumee and the Miami. As this same water-shed extended westward into Indiana, the same conditions were undoubtedly continued, and we may expect to find ancient channels in our Indiana summit region. The higher elevation of "Lost Mountain" did not offer as easy a passage-way as the lower moraine northward.

The summit between the Mississinewa and the Salamonie is nearly 100 feet higher, on an average, than that between the Salamonie and the Wabash, the latter being 383 feet, and the former 480. The receding waters in their decline, constantly close the lowest outlet. Their effect is naturally seen on the lowest ridges. The higher ridge shows no such results, being intact and unassorted.

The northern morainic ridge, on the contrary, was cut asunder by the superfluous waters of the Fluvial epoch, and much of its mass reassorted and modified.

The ancient river entered the county from the northeast, coming in at section four, of Bear Creek township, passing in

a southwest direction, traversing the region known as the "Loblolly," then following the line of "Haines' Ditch," passing out of the county through the prairie northwest of Camden. It probably finds its continuation through Blackford county, with a deflection in its course to the southward. Such a channel is crossed by the railroad four miles southeast of Hartford City. It has been traced southward across Delaware, into Henry county, thence probably into the great valley of "The Collett Glacial river."

This channel is one of very marked features, being in places so distinctly an ancient river bed, that it is known to the inhabitants as the "Lost River." The deposit of alluvium is very deep. The part of this channel known as the "Loblolly" is simply a portion of the old bed that was deeper than the rest, and was not so much filled up. A succession of small lakes, very narrow and deep, extend throughout its whole length. They are simply portions of the old bed that are gradually filling up with organic matter. Some of them are said to have sandy bottoms, with a shore of mucky material. The water has little or no current, moving sluggishly toward the Wabash.

The divide of the waters in this ancient channel is in a shallow pond in section 19, Jackson township. From this point "Haines' Ditch" follows the bed of the old stream, being raised above the ancient bed by alluvial deposits. The ditch has a gentle fall to the Salamonie, winding through this valley as a mere rill, where formerly poured a flood at times two or three miles wide, and perhaps two or three hundred feet deep.

Evidently the waters moved at times with the current of a rushing torrent. This deep channel passes through the barrier of blue clay, striking it in the western part of Jackson township, throwing up masses of sand and gravel into ridges that rise to a height of eighty feet above the *present surface* of the valley, as at "Tusey's Knob," section 24, of Penn township, and the ridges of similar appearance in the adjacent sections 25 and 26. These ridges stand directly in the line of the channel with their axes at right angles with its current. The first of these ridges are steep and abrupt. The succeeding ones to the southwest are gradually lower, and thin out towards Cam-

den, where the gravel and sand are found in deposits from six to ten feet thick, lying on the blue clay. All these deposits of sand and gravel have the usual "flow and plunge" structure, showing in their arrangement the action of water currents flowing at varying rates and depths.

In the higher ridges, as was observed in "Tusey's Knob," the stratification of the material is oblique and irregular; alternating layers of fine sand, and coarse gravel. These ridges are genuine "hog backs." The sides of "Tusey's Knob" are steep, and the summit is very narrow, coming up in places to a very sharp peak, from the top of which is a beautiful view, taking in at a glance the outline of this ancient valley.

North of this series of sand ridges undisturbed morainic material lies as a mighty barrier, having been penetrated to a great depth. In section 13, Penn township, a well was dug to a depth of 130 feet. South of this channel the general shore line is a barrier of unstratified boulder clay, wells eighty and ninety feet deep not reaching the bottom. Previous to the Fluvial epoch, this morainic mass was continuous throughout the northwest part of the county. The sand ridges are the product of its reassortment. They exhibit the action of strong currents of water dashing over bars and shoals. The channel northeastward was deeper, and its flood striking this clay barrier excavated an outlet, reassorting the material, and mingling new ingredients, threw it up into the sand bars and shoals that now constitute the sand ridges and the gravel deposits in the vicinity of Camden. All the other gravel deposits of the county had this origin; but the beds elsewhere, as a rule, are much thinner in comparison, few of them exhibiting the assorting influence of deep and rapid currents.

The gravel found in the vicinity of West Liberty, section 13, Jackson township, is one of the broad sand bars of the southern shore of this ancient river. The shallow lateral deposits apparently alternate from side to side throughout the "Lob-lolly" region. They all rest upon beds of blue clay.

The conclusion is then made that the ancient inland sea had at this point an outlet identical and synchronous with those crossing the Summit region in Ohio. The earlier floods may have submerged much of this region, but their recession would gradually confine their volume to more specific limits, produc-

ing the broad outlets, with strong currents, reasorting the drift and depositing it in the ridges that are characteristic of this Summit region.

These ridges have a general parallelism of outline with the more recent shore lines of Lake Erie; namely, the lake ridges found in Western Ohio, the highest one extending into Indiana to Fort Wayne, where the waters of Lake Erie at that period had an outlet through the Valley of the Wabash. The "sand ridges" are older than the "lake ridges," the channels producing them being closed before the outlining of these ridges. Upon this distinction Professor Newberry says: "Careful observation will show that this belt of sand and gravel hills has little in common with the lake ridges, being composed of different materials, holding a higher level, and being far less continuous and uniform in altitude." (Vol. I, Ohio Survey, p. 43.)

Many inquiries in various parts of the county elicited no discovery of the so-called "Forest Beds," traces of which are found in many localities southward.

The deposits of drift, both glacial and fluvial, both the clays and the gravel, abound in fossils, many of them somewhat weathered. The most abundant are Devonian species; many fragments of limestone from the formations of that age being full of corals and shells. These are abundant in the gravel. The summit of "Tusey's Knob" is thickly strewn with them.

In the blue clays, and only in the blue clay, are frequently found fossils belonging to the Hudson river rocks of the Lower Silurian. A number of species have been identified. In a piece of shale found in the clay in section 16, Wayne township, resting on a large granite boulder, was found a Lower Silurian Lamellibranch *Ambonychia costata*. Trilobites are frequently found in the boulder clay, and all of Lower Silurian species, being *calymene blumenbachi*, curled up, just as found in the Lower Silurian shales at Richmond and Madison. It is not known that Lower Silurian fossils have been before found in the drift of Northern Indiana. Their presence here would indicate the existence of Lower Silurian formations to the northward or eastward. But the oldest exposures, so far as known, are the Upper Silurian. If the glaciers reached the Hudson River formation at any point it may have been in the deep erosion at some unknown point.

Dr. Arthur, of Portland, has a number of these specimens in his cabinet, one being exhibited that was taken from the blue clay, twenty feet below the surface, in a well near Camden. They are frequently found in nearly every part of the county.

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## PALÆOZOIC GEOLOGY.

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The only rocks found in place in Jay county belong to the Niagara group of the Upper Silurian period. Of these there are only two outcrops, neither of them sectional exposures, but only surface showings in the beds of streams, the one being in the Salamonie, near Portland, and the other in the Wabash, at Jay City. Throughout the county the formation is heavily overlaid with drift. Over a good portion of Wayne and Greene townships the limestone is very near the surface. In the center of this region is the Salamonie outcrop, located in range 14 east, township 23, section 30. A quarry has been partially opened, but owing to high water at the time of my visit it was not seen in place. But an examination of a mass of stone that had been quarried showed it to be a shale of drab color, porous and argillaceous layers, stained in places with red oxide of iron, also abounding in fragments of chert. Some of the strata were full of fossils, the most numerous being *Pentamerus oblongus*, with corals of the genus *Favosites*. One cast of *Pleurotomaria* was observed; the species could not be determined. Many of the fragments were full of crinoid stems. None of the stone exposed is adapted to building purposes. It has been used in making an excellent lime. The rock is easy of access, the alluvial deposit at this point being very shallow. The opening of a quarry will probably expose stone of a better quality.

Considering the fact that this is the only outcrop near Portland, there is promise of profit in opening and operating it. This, we are informed, the owner, Dr. Arthur, intends doing at an early day.

The second outcrop, and much the largest exposure, is in the extreme northeast part of the county, at Jay City, in the bed

of the Wabash. It is also a surface exposure, and no section could be taken, neither was the dip accurately distinguished, though the workmen state the general trend is northward.

The rock is near the surface for a long distance in the bed of the river, there being exposures in Adams county, westward, and near the Ohio line, eastward. North and south the rock is near the surface. A mile south of Jay City it appears in section 4, Wabash township, in the bed of a small branch, and in many wells in the vicinity, with an average depth of ten or twelve feet. The stone differs in appearance from that at Portland, being a porous, lenticular limestone of a light color, with very little of argillaceous and arenaceous ingredients. The surface layers only have been quarried. It makes an excellent lime, and is burned to meet the local demand.

The superior quality may be inferred from the character of the stone. These shales are full of fossils; many of them fragmental and imperfect, the crystalline purity of the rock preserving them generally as casts.

The following species were collected and identified. Further search will discover others:

*List of Fossils Found in the Niagara Shales at Jay City.*

<i>Stromatopora concentrica</i> .....	Goldfuss.
<i>Halysites catenulata</i> .....	Linneus.
<i>Favosites favosus</i> .....	Goldfuss.
<i>Favosites niagarensis</i> .....	Hall.
<i>Favosites venustus</i> .....	Hall.
<i>Zaphrentis stokesi</i> .....	Edwards & Haime.
<i>Spirifera eudora</i> .....	Hall.
<i>Spirifera stricklandi</i> .....	Sowerby.
<i>Strophodonta profunda</i> .....	Hall.
<i>Pentamerus oblongus</i> .....	Sowerby.
<i>Pleurotomaria</i> , two species too indistinct to determine.	
<i>Trochoceras</i> , species not determined.	
<i>Atrypa reticularis</i> .....	Linneus.
<i>Conularia niagarensis</i> .....	Hall.
<i>Eucalyptocrinus crassus</i> .....	Hall.

## ARCHÆOLOGY.

The antiquities of Jay county are full of interest. Though there are no extensive earth-works, the whole region abounds in relics of the aboriginal and pre-historic peoples. The characteristic implements, utensils and ornaments have been found in every township—such as grooved axes, hammers, pestles, fleshers, arrow-heads, totems, pipes and pottery. The only mounds observed were very small, and almost obliterated, being in two localities—one group of five small ones, located in section 35, Penn township; another of three similar mounds in section 13, Knox township. They are all obscurely oval, being from twenty-five to fifty feet in length, and from three to five feet high. Some have been almost obliterated by cultivation.

Dr. Arthur, of Portland, has thoroughly investigated their structure, but they have yielded no specimens, either in implements, pottery or bones. All of them contained ashes and alternating layers of clay, burned brick red, and beds of charcoal. They were probably habitation mounds, and possibly some of the outlying villages of that numerous people who have left monumental evidences in the great earth-works of Winchester and Anderson that this region was a center of their national power. While the mounds are thus unimportant, the relics gathered from various parts of the county are full of interest.

Their abundance and variety has attracted the attention of many collectors. Extensive collections have been made by Dr. C. S. Arthur, of Portland, Gen. J. P. C. Shanks, Mr. John Lalley. Dr. Porter, of Geneva, Adams county, also has a large number of fine specimens, many of them gathered in Jay county.

These various collections include a variety of articles not often equaled in a single county. Much of the workmanship is quite elaborate, showing in execution both taste and skill. The hardest rock has been fashioned and polished into symmetry and beauty. The excellence of the work is amazing as we remember it was wrought by men who had no knowledge of the harder metals.



The variety of material used is astonishing. We have observed Indian arrow-heads of all descriptions, flints of every color, even to green. One arrow-head, in possession of Gen. Shanks, is made from crystalline quartz. Most of the stone axes are made of granite, in its various forms of syenite, diorite, or greenstone. The pipes are usually steatite, or soapstone. Some of these are of curious form, and exhibit considerable skill in copying natural objects. Dr. Arthur's collection contains one that is a fair representation of an otter, and another a good imitation of a rattlesnake's head.

Tubular pipes are met with. One in the possession of Dr. Porter, at Geneva, is about ten inches long, made of steatite. The bowl is funnel-shaped and horizontal, not turned up in ordinary pipe form. A shorter one in Dr. Arthur's cabinet shows the marks of the teeth of some energetic smoker.

Occasionally throughout this county rounded masses of a flinty silicious stone are found, having a sharp angular fracture, quite spheroidal in form, and varying in size from a hen's egg to the fist of a man. They have evidently been used as implements. They are not the ordinary hammer stones, having neither grooves or polished surface. All of them have the sharp angular pointed appearance on the sides where the laminations of the material end. They all have this characteristic. Only a few of them have been found.

Dr. Arthur suggests their use in the manufacture of implements from the granitic rocks. It was found upon trial that the burned edges of these stones would readily disintegrate the hardest green stone, when applied with continued yet gentle blows. The sharp points granulated the granite very rapidly, and a few hours only would suffice to form a battle-axe or pestle from any syenitic boulder.

We have not learned whether implements of this description have been observed in other localities. We offer this as a suggestion of their probable use.

Near the Salamonie, south of Portland, on the land of Mr. Jonas Votaw, in section 28, Wayne township, is a deposit of sand and gravel, in which were found at one time seventeen human skeletons, lying at a position below the present level of the Salamonie, apparently an ancient sepulcher. The bones and relics were all in an advanced stage of decay, so that many

crumbled on exposure. The only relics preserved were a tubular pipe of steatite, and what is evidently the *osselet* of a squid or calamary, the internal bone or shell of a cephalopod, called the "pen," from its pointed, pencil-like form. The specimen is a perfect one, with the conical cavity at the lower end, showing distinctly its nature. It must have been transported from the sea coast as an ornament. Other relics of similar nature and origin have been discovered, indicating tribal communications among the ancient people, and interchange of commodities.

In a gravel pit just south of Portland, in section 20, one of those broad, shoal-like deposits of gravel and sand, overlaid by a few feet of yellow sedimentary sandy soil, was found a locality, about three feet below the surface, where ashes and charcoal were found mingled with the gravel, some of the bowlders showing the action of heat. Associated with them were fragments of pottery, of rather a rude character, yet exhibiting some symmetry of outline, with traces of ornamentation, being decorated by marks made with the finger-nail before the baking of the pottery. There were no indications on the surface of any disturbance of the soil; no irregularity of outline either in elevation or depression. It is probable that a small habitation mound had once occupied this spot, that in such yielding, sandy soil had, in the lapse of ages, been wholly obliterated.

#### THE MASTODON.

The gigantic mammals of the early quaternary have left their remains in various portions of the county, its heavy alluvium and muck deposits being very favorable for their preservation. Bones of the mastodon and the post-glacial deer or elk have been frequently met with. The gigantic antlers of the latter have been found, in size indicating an animal eight or nine feet high and ten or eleven feet in length. These antlers have been picked up in a bog north of Camden, in Penn township.

Fragments of the skeleton of the mastodon have been met with in various places, vertebræ, ribs and teeth usually quite well preserved. In a locality in the western part of Penn township numerous fragments have been gathered, indicating the presence of an entire skeleton, that will be exhumed at an

early day. One of the shoulder-blades now in the possession of Dr. Arthur indicates a monster of immense proportions.

It is probable that the proposed draining of the "Loblolly" region will discover well preserved skeletons of the mastodon, which it is hoped will be carefully preserved in the interest of science.

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## ECONOMIC GEOLOGY.

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### SOIL AND WATER.

What has been said previously of the surface configuration of Jay county is suggestive of the general condition and character of the soil.

It is mainly of drift origin, and the commingling of sand and clay with organic material of vegetable origin, has produced a very fertile soil.

Much of the surface is covered with several feet of rich, black loam, showing a soil of inexhaustible fertility. Some of the land is low, but all of it is capable of perfect drainage. Clays for drain tiles are abundant, and of excellent quality. Factories are being rapidly multiplied and the production of tile is really a great industry. Everywhere the benefits of drainage are apparent. Land formerly deemed worthless is waving with magnificent crops of wheat and corn.

The benefits of drainage are not confined to increased fertility in the soil by carrying off superfluous water, but thorough drainage has enhanced the healthfulness of the whole county. The work is not completed yet, but the introduction of drainage has been attended by a marked decrease in all malarial diseases, formerly the terror of this locality.

One reason for this result is that drainage improves the quality of the drinking water.

Surface water is swiftly carried off, and the shallow wells supplied by it become dry, and are replaced by deeper ones, which penetrate to the purer waters of the lower sand strata. Shallow wells full of swamp water are mere pools of pestilence, in which the germs of disease are generated.

Certain localities in the county have experienced great difficulty in procuring good water. This, as far as we observed, is limited for the most part to the higher clay ridges. The water is locally known as "bitter water." To the taste it is rather nauseating, being sweetish rather than bitter. It acts as a cathartic, and is generally considered unhealthful.

Animals acquire a taste for it and thrive on it. When accustomed to its use they prefer it to any other water. The largest region with water of this character is a belt of land from two to three miles wide, coincident in extent with the outline of the summit of the southern ridge of the county. It exists in patches along the line of the northern ridge, and usually lacking the marked characteristics, being less bitter and nauseating. It appears to be limited to the clay formations—never found in alluvial or gravel deposits. It is evidently a surface water, the deeper waters being usually pure and potable. In one or two instances we saw two wells near each other—even within a few feet—one being "bitter" and the other good water, the good water coming from the lower level below the hard pan. The remedy, therefore, is a tubed well, carefully sunk to the lower water, otherwise the "bitter water" will be intermingled.

Samples of this water from a well at Mount Pleasant were submitted to Professor Elwood Haynes, of Portland, for examination. The following is his report:

*Qualitative Analysis of "Bitter Water" from Mt. Pleasant, Jay County, Ind.*

Free carbonic acid.

Carbonate of calcium.

Carbonate of iron.

Carbonate of magnesium (trace).

Sulphate of magnesium (epsom salts).

Sulphate of aluminum (trace).

Chlorides (trace).

The sulphate of magnesium existed in quite large quantities, and is, undoubtedly, the cause of the bitter taste of the water. The well-known cathartic, "epsom salts," is sulphate of magnesium. To a sample of water similar in composition to the above, except that it contained no epsom salts, was added a small quantity of that substance (obtained from a druggist),

and the result was a bitter water which could not be distinguished from the sample analyzed. Moreover, after all the other constituents of the water, save that of the sulphate of magnesium, were removed, the water still retained its bitter taste. The carbonates of iron and calcium existed in considerable quantities, and were held in solution by the free carbonic acid contained in the water. No test was made for phosphoric acid, as the necessary requisites could not be obtained in this place.

For the benefit of those using bitter water of the above description, I would say that the bitterness of the water may be almost entirely removed by adding a requisite quantity of lime. The quantity of lime to be added depends entirely upon the amount of salts contained in a given quantity of the water, and can only be determined by trial."

This suggestion of the Professor ought to be practically tested by those who have wells of this water—where it is not convenient to put down tubed wells to the pure water below.

The continued use of water containing such ingredients can not fail to be detrimental to physical welfare. A little lime thus used might avert much sickness.

The analysis indicates that all the causes of the bitterness of the water are present in the soils of these localities. The heavy clays retain the chemical agents that characterized the rock from which they were made. The limestones dissolved by glacial and chemical action were largely composed of the carbonates and sulphates that are held in solution in these waters.

The undisturbed portion of this mass of material, its compact, close-grained structure, produce conditions favorable to the preservation of these elements in the soil. The surface-water sinks down through the clay and takes up these ingredients, becoming especially charged with the sulphate of magnesium, giving its bitterness. If the surface waters could sink to the lower strata, the deeper waters would also be bitter, but the hard-pan prevents such impregnation, the deeper waters having an artesian flow, with a fountain head where the soil is not charged with epsom salts. It is probable that there are places where the hard pan is penetrated by the bitter surface waters. At such points the deeper waters will also be bitter, and may give some the impression that the waters of both strata are alike bitter. But such exceptions need not disturb the general rule that the lower waters are quite uniformly

pure and potable. The construction of cisterns would answer the purpose where tubed wells are not desirable or practicable, and would always furnish the purest water.

At various points strong springs were observed, some of them quite heavily charged with iron and sulphur. In a low, marshy region in Greene township, section 17, a strong "sulphur" spring was observed; another in section 35, in Noble township. The numerous springs of never failing water are a compensation for the absence of flowing streams, that renders this county very favorable for grazing purposes. While in dry seasons the small streams become stagnant or wholly dry, these fountains are always accessible, and are invaluable to the stock raiser.

For this reason the whole county is well adapted to the raising of cattle and sheep. Numerous flocks and herds of fine live stock indicate that the capacities of this county in this direction are beginning to be properly appreciated.

#### THE TIMBER AND FLORA.

The county was originally an almost unbroken forest. It still contains a vast amount of most excellent timber. At present there is a large local and foreign trade in the hard woods, for building and manufacturing purposes. Oak, ash and hickory are found abundantly in every township. Oak is especially abundant along Bear creek. The sandy land of Jackson and Penn townships abounds in walnut, wild cherry, hard maple and butternut. The alluvial valleys are full of lofty sycamores and gigantic burr-oaks. The whole "Loblolly" region is stocked with a dense growth of majestic elms, oaks, ash and maples.

The following is a list of the more important trees, shrubs and vines found growing in the county:

#### LIST.

<i>Acer saccharinum</i> .....	Sugar maple.
<i>Acer rubrum</i> .....	Red maple.
<i>Acer dyascarpum</i> .....	Soft maple.
<i>Amelanchier canadensis</i> .....	Serviceberry (rare).
<i>Asimina triloba</i> .....	Paw-paw.
<i>Aesculus glabra</i> .....	Ohio buckeye.

<i>Aesculus flava</i> .....	Sweet buckeye.
<i>Crataegus coccinea</i> .....	Red hawthorn.
<i>Cornus florida</i> .....	Dogwood.
<i>Cornus canadensis</i> .....	Bunchberry.
<i>Carya alba</i> .....	Shell-bark hickory.
<i>Carya glabra</i> .....	Pig nut.
<i>Carya tomentosa</i> .....	White heart hickory.
<i>Corylus americana</i> .....	Hazel nut.
<i>Celastrus scandens</i> .....	Bitter sweet.
<i>Carpinus americana</i> .....	Iron wood.
<i>Cercis canadensis</i> .....	Red bud.
<i>Cephalanthus occidentalis</i> .....	Fever bush.
<i>Celtis occidentalis</i> .....	Hackberry.
<i>Euonymus atropurpureus</i> .....	Waahoo.
<i>Fagus ferruginea</i> .....	Beech.
<i>Fraxinus americana</i> .....	White ash.
<i>Fraxinus sambucifolia</i> .....	Black ash.
<i>Fraxinus quadrangulata</i> .....	Blue ash.
<i>Gleditschia triacanthus</i> .....	Honey locust.
<i>Hamamelis virginica</i> .....	Witch hazel (rare).
<i>Juglans nigra</i> .....	Black walnut.
<i>Juglans cinerea</i> .....	Butternut.
<i>Morus rubra</i> .....	Red mulberry.
<i>Morus nigra</i> .....	Black mulberry.
<i>Nyssa multiflora</i> .....	Black gum.
<i>Negundo aceroides</i> .....	Box elder.
<i>Populus tremuloides</i> .....	American aspen.
<i>Populus heterophylla</i> .....	Downy-leaved poplar.
<i>Populus monilifera</i> .....	Cotton wood.
<i>Prunus serotina</i> .....	Wild cherry.
<i>Platanus occidentalis</i> .....	Sycamore.
<i>Quercus macrocarpa</i> .....	Burr oak.
<i>Quercus alba</i> .....	White oak.
<i>Quercus nigra</i> .....	Black oak.
<i>Quercus rubra</i> .....	Red oak.
<i>Quercus prinoides</i> .....	Chinquapin.
<i>Sassafras officinale</i> .....	Sassafras.
<i>Salix nigra</i> .....	Black willow.
<i>Salix humilis</i> .....	Low bush willow.
<i>Salix discolor</i> .....	Glaucous willow.

<i>Staphylea trifolia</i> .....	Bladder nut.
<i>Tilia americana</i> .....	Linn, or basswood.
<i>Tecoma radicans</i> .....	Trumpet creeper.
<i>Ulmus americana</i> .....	Elm.
<i>Ulmus fulva</i> .....	Slippery elm.
<i>Viburnum prunifolium</i> .....	Black haw.
<i>Vaccinium macrocarpa</i> .....	Cranberry.
<i>Zanthoxylum americana</i> .....	Prickly ash.

It is noticeable in this list that White Poplar (*Liriodendron tulipifera*) is wanting. It was not observed anywhere in the county, and if it exists at all it is very rare. It is stated that the "leather-wood" (*Dirca palustris*) existed, but careful search failed to find it. In one locality we noticed the *ailanthus*, an Asiatic tree (Tree of Heaven), growing as a forest tree. Witch Hazel is found in but two localities—near Antioch, in Pike township, and near Camden, in Penn. The "Loblolly" marsh abounds in rare plants, and its beautiful orchids, gigantic grasses, sedges and ferns, make it a botanist's paradise. Vegetation grows very rank and dense, with almost a tropical luxuriance. Some of the ferns were four and five feet high. The aquatic reeds were very tall. One species, *Phragmites communis*, being twelve feet high.

#### ROADS.

One of the conditions of prosperity is a net-work of good, solid roads. These are beginning to be appreciated, and numerous well-constructed gravel roads exist. But much needs yet to be done in this direction before the facilities for transportation will be proportionate to the production. The difficulty heretofore has been a lack of material, but careful search has shown that in almost every locality a supply of gravel can be found, though in some instances it must be carried quite a distance. The shallow beds of gravel in the level land will furnish, ordinarily, an adequate supply for local demands.

The great sand ridges of Penn township are an inexhaustible store-house of road material, that will some day be utilized. The gravel is clean and sharp, and of the very best quality.



## EDUCATION.

One of the pioneer colleges of Indiana was formerly located near Portland, and known as Liber College. It has passed away as an institution, but the present intelligence of the people owes much to its early influence.

The present public schools are well equipped, and doing a work under the efficient superintendency of Prof. Houk.

The Portland city schools are well managed, and are fully up with the educational progress of the times.

Funds have just been subscribed for the establishment of a Normal School, which will soon be built, and promises to be a flourishing educational institution, that will find ample room for service in equipping the young teachers of Eastern Indiana for the great work of training children for the duties of citizenship.

## THANKS.

In this survey we have been aided materially by the hearty co-operation of the generous and public spirited citizens of Jay county. We are especially indebted to Dr. C. S. Arthur and Gen. J. P. C. Shanks, for many courtesies and acts of kindness. Also, to Mr. Culver, Mr. John Y. Miller, Rev. T. C. White, D. D., Prof. Elwood Haynes, Prof. Houk, Dr. Wiest, of Jay City; Dr. Muncy, of West Mt. Pleasant, and especially to Mr. Geo. K. Greene, of New Albany, for the identification of fossils.

## GEOLOGY OF RANDOLPH COUNTY.

By A. J. PHINNEY, M. D.

Randolph county is situated on the eastern line of the State, and has for its boundaries: Darke county, Ohio, on the east; Jay county, Indiana, on the north; Henry and Delaware on the west, and Wayne county on the south. It is one of the largest counties of the State, and contains 284,177 acres, a good part of which is improved. It is well supplied with railroads. The Cleveland, Columbus, Cincinnati & Indianapolis road is crossed by the Fort Wayne, Richmond & Cincinnati, at Winchester. The Pittsburg, Cincinnati & St. Louis passes through Union City and Ridgeville, while the branch of the I., B. & W., lately completed, affords an outlet for the products of the southern portion. Its principal cities are Winchester, the county seat, and Union City, both of which are enterprising towns, having a steady and permanent growth, and though mostly engaged in commercial pursuits, in both may be heard the busy hum of manufacturing enterprises. The Court House at Winchester is a fine building, and justly deserves to be the pride of the people.

Of smaller towns, the principal are Ridgeville, Farmland, Lynn, Spartansburg, Huntsville, Losantville, Windsor, Harrisville and Macksville, all enterprising towns, Farmland and Ridgeville being the largest, each containing about eight hundred inhabitants. At the last named is located Ridgeville College, which is under the control of the Free-Will Baptist denomination. "It is the aim of the instructors that it shall be free from sectarianism, yet the principles of a sound morality and the higher Christian life are carefully guarded and assiduously inculcated." Although starting under unfavorable auspices, they have secured a fine building, are now nearly free from debt,

and with classes increasing from term to term, its friends are looking forward with high anticipations of a useful and brilliant future. The Faculty is composed of the following able instructors:

REV. S. D. BATES, A. M., President, and Professor of Mental and Moral Philosophy.

REV. THOMAS HARRISON, A. M., Professor of Latin and Greek.

ELIAS BOLTZ, B. S., Professor of Mathematics and German.

MISS JOSEPHINE SUMPTION, B. S., Preceptress and Teacher of French.

MISS EMMA HARKER, Teacher of Instrumental Music.

R. FRICKE, Adjunct Teacher of Instrumental Music.

The courses of study are the Classical, Scientific, English and Normal. The terms are arranged to accommodate those who desire to teach during the winter months. Friends of the college everywhere will bear in mind that donations to its library or museum will be thankfully received.

#### SURFACE CONFIGURATION.

The surface is generally level or rolling, with the exception of three ridges in the southern part, which might in places be termed hilly. These ridges are highest south of the water-shed, owing to the erosion of the valleys during the slow elevation of the divide. The surface near the water-shed is usually level, but grows more hilly as you go towards the south line of the county. North of White river is a low ridge, forming the water-shed of the northern part. The highest land in the State is formed on the middle ridge near Bloomingsport (one and a half miles northwest), on the summit between Green's Fork and Martindale creek, the elevation of the road bed of the I., B. & W. R. R. being here 1,234.40 feet above the ocean. Colonel Moore, Chief Engineer, estimates the elevation of some of the hills south of this point to be at least fifty feet higher, making the highest point in the State about 1,285 feet above the ocean. Hills on the east ridge are nearly as high. The following table of altitudes of the road bed of the I., B. & W. R. R. was furnished by Colonel Moore, Chief Engineer. The base line of this road places the Union Depot, at Indianapolis, at 721.20 feet above the sea level.

## TABLE OF ALTITUDES.

	<i>Feet Above Ocean.</i>
West line of Randolph county.....	1,171.50
One-half mile south of Losantville.....	1,140.60
Valley of Nettle creek .....	1,129.40
Summit between West river and Nettle creek.....	1,186.10
West river valley bridge.....	1,120.00
Township line at Hoovers' sawmill .....	1,220.00
Summit between Martindale creek and Green's Fork..	1,234.40
Crossing of Richmond, Ft. Wayne R. R. near Lynn...	1,173.80
Elevation of Lynn Station.....	1,183.00
Summit on line between Washington and Green's Fork townships.....	1,187.50
Summit west of boundary road.....	1,220.00
Divide of drainage between Noland's Fork and Green- ville creek.....	1,186.00
Summit between Noland's Fork and east fork of White Water.....	1,214.60
State line one mile north of the southeast corner of the county.....	1,180.44
East of the point last named, the descent is gradual to the Miami Valley.	
Low water Mississinewa river, at Ridgeville.....	964.00
Summit between Mississinewa and White rivers.....	1,095.00
Winchester, crossing of Bellefontaine R. R.....	1,088.00
Union City, C., C., C. & I. R. R.....	1,107.00

The county, as a whole, is one of the most elevated in the State, its southern part forming the water-shed of eastern Indiana. Streams flow in every direction from its summit. The principal rivers are the Mississinewa and its branches, viz.: Elkhorn and Bear creeks and the Little Mississinewa; White river and its tributaries, viz.: Little White river, Cabin creek, Sugar creek and Salt creek, in the central part. South of the divide, West river, Martindale creek, Green's Fork and Noland's Fork of White Water river, while on the east, Greenville and Dismal creeks drain the swampy tracts near the summit. All these streams supply an abundance of water for stock, though none are hardly large enough to furnish much water-power for manufactories. Where streams are not accessible, water can usually be obtained by wells; the depth varying from ten to thirty

feet. Springs are numerous, though mostly small, and the character of the water such as is usually found in limestone regions, though a few were observed which are chalybeate.

Nearly all the larger streams of the county have their sources in broad, swampy tracts, which, when the country was first settled, were almost impassable, and were from one quarter to two miles wide, and the larger from five to six miles long. The water-shed between Noland's Fork and Greenville creek is hardly perceptible, and the broad prairie which now borders both these streams can be traced from the south line of the county, with a direction a little east of north, to a point east of Union City, from thence continuing in the same direction for fifteen miles through the northwestern portion of Darke county, Ohio. South of Union City a branch of this prairie crosses the east ridge and extends in a southwesterly direction to the valley of Green's Fork, forming the broad prairie from which Dismal creek, the east branch of Green's Fork and White river have their sources. Cabin creek and West river rise in another long, swampy tract, which lies to the east of the west ridge. North of West River township, this swampy tract extends for about two miles. Bear creek and the stream from the north, which empties into the Mississinewa river a short distance above the mouth of Bear creek, are in the same line. The streams which occupy these broad valleys could never have excavated them; in fact, until ditches were cut, they had not even made a channel for themselves. They evidently mark the course of glacial rivers, flowing from the northeast to the valley of the Ohio or the ocean. The direction of the flow of these ancient streams, at right angles to the present lines of drainage, shows that the surface at the north was relatively much higher than at present, and that the divide, now so prominent a feature of the surface configuration, hardly had an existence at the close of the Glacial epoch. The three ridges are only remnants of the broad table land which once existed, the glacial streams having carried away the material which once united them. The hills, so prominent a feature of the southern part of the ridges, were carved from the level table land by currents of water. They have nothing in common with those hills of sand and gravel (kames) found so frequently in Delaware county and other portions of the State.

Union City is situated on the east ridge, and the people have always had more or less difficulty in obtaining water. In order to secure a supply for water works, an excavation was made southwest of the city, thirty feet in diameter, and twenty feet deep. A drill was then sunk twenty feet more, striking a vein of water which filled the well and overflowed the top, and has since continued to supply the city with clear, cold water. They evidently tapped the ancient channel which passes a little to the east. In draining the swamps, elks' antlers have been found; some very large and having a spread of six feet. Remains of the mastodon have been occasionally met with.

North of the Mississinewa river, in Jay county, is a ridge known as the Lost Mountain. This ridge has a similar position, and evidently originated in the same manner as the low divide north of White river. Overflows from the Glacial river evidently once covered most of Wayne and White River townships, finding an outlet through the channel marked "probable course of Glacial river." Although no deep channel was formed, enough material was removed to give to the remaining portion the character of a ridge, and the erosive action of White river has still further contributed to that result. A similar condition prevails north of the Mississinewa river, in fact that channel marked "probable course of Glacial river" can be traced through Randolph to Jay county. West of Ridgeville it curves to the east, and with a somewhat circuitous course terminates in the main channel in Darke county, Ohio, making probably the supposition that the ridge is the result of erosion.

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## GENERAL GEOLOGY.

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### QUATERNARY AGE.

Under this head may be classed all those deposits which have taken place during and since the close of the Glacial epoch, and it embraces all those accumulations of peat, muck and vegetable mold which are now among the very best farming lands in the county. The largest of these deposits occur in the valleys of those ancient rivers, their channels having been silted

up with sand and gravel, leaving, at first, series of shallow lakes. All depressions in the surface were left filled as the waters slowly receded. These lakes and ponds, after a long period of time, became filled from the accumulations of an aquatic vegetation and the wash from the higher lands. Although shunned by the earlier settlers, the judicious use of ditching has redeemed these wastes, and now, over a great part of these prairies, may be seen the fields of golden grain. The depths of these deposits varies from two to ten feet, the lower part, in places, resembling a marl. The largest of these prairies are found bordering Greenville and Dismal creeks, on the east, and Cabin creek and West river, near the southwestern part of the county. Smaller accumulations of muck occur in every township.

#### ALLUVIUM.

All the streams of the county being small, no very extensive alluvial deposits are found here. The valleys of the Missis-sinewa and White rivers afford the best example of this formation. Although limited in extent, they are noted for their fertility—a characteristic of these deposits wherever found. Formed from the finer clay and sand washed from the higher lands, and mixed with vegetable detritus, they have every element necessary for the production of magnificent crops.

#### THE DRIFT.

This deposit covers the whole county, the depth ranging from twenty-five to possibly one hundred feet. It is here a gray and yellowish clay, with some sand and gravel in the deeper portions. From ten to thirty feet of clay is passed through, in digging wells, before gravel is reached. The depth of the surface clays, together with their extent, and the numerous large bowlders which are found on the surface are records of the melting of extensive glaciers. The clays, sand and gravel, which are scattered over such a large extent of territory, tell us of the mighty force which ground to powder the shales, destroyed the cohesion of sandstones, and brought from the Canadian highlands mere remnants of those azoic rocks that were torn from their parent ledges.

If, standing upon the summit of Little mountain, Lake county, Ohio, 750 feet above the surface of Lake Erie, one will

fill, in imagination, that vast vacuity which probably extends to the Canadian shore with the Erie shale, Waverly group and Carboniferous conglomerate, which once occupied it; he will be able to form some conception of the mighty force which excavated the basin of Lake Erie, and scattered the debris over Indiana and Ohio. That great glacier moved from the north-east to the southwest, and the Little mountain, with its precipitous walls facing the lake, indicates the position of the land side of that glacial plow. Probably the low divide, which extends from Northeastern Ohio into Indiana, passing through the southern part of Randolph county, marked the southern border of this glacier. This was followed by the great glacier from the north, which covered the continent as far south as the fortieth parallel of latitude. As this melted, leaving the debris of its work of destruction behind, to be sorted by the volumes of water flowing from it, a depression of the continent took place, the glaciers dropped their loads of gravel, sand, clay and boulders. After this part of the Ice age the surface clays were deposited, and the future wealth of the soil determined. During the period of elevation which followed, the sheet of clay was cut through by the rivers which were draining the waters from the basins of the great lakes. As the rivers flowed across the divide, they excavated those deep and broad valleys now occupied by Greenville and Dismal creeks, Cabin creek, and West river. Portions of the table land separating them were subject to the action of currents of water, which carved those rounded hills, so common near the summit of the divide. As the lake basins became drained, the ancient river channels were silted up, in many places wholly obliterated, leaving only a series of shallow lakes to mark their former course. During this last act in the great drama of water and ice, the surface configuration of the county was marked out. Gradually, with a continued but unequal elevation, the present lines of drainage became established at right angles to those ancient river channels.

#### . BOULDERS.

Boulders are common everywhere, but are found in greater numbers in the southern part, near the summit of the divide, the erosion which this part of the county has suffered having



carried away the finer material, leaving them exposed. East of Windsor and south of White river is a line of bowlders, extending nearly to Macksville, many of which are of large size. In section 29, White river township, range 14 east, 20 north, is one thirteen feet long and five feet above the surface, and with not less than five or six feet imbedded in the earth. West of Fairview and south of the Mississinewa river is another nearly as large. Quartzytes, greenstones and granites are the prevailing kinds. Many of the quartzytes are of great size, and show by their well rounded forms the rough usage to which they have been subjected. The greenstones (Dioryte, with others of the Hornblende series) are, many of them, large, and are usually angular. All forms of granites occur here. The transition into the gneissoid rocks, however, is rare, the tendency of the gradations being towards the Syenites. But few limestones were found. In many places bowlders were so numerous that the farmers were compelled to haul them off their fields. The immense piles along the roadsides afforded ample opportunity for their study.

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### PALEOZOIC GEOLOGY.

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The only rocks found in the county belong to the Niagara period, Upper Silurian age. But few exposures occur, and only along the larger streams. At Macksville, on White river, is an outcrop exposing a thickness of about six feet of a soft, friable and coarse grained limestone of a whitish cream color, becoming yellowish on exposure, judging from what was seen on the surface. This is suitable only for lime, of which it makes an excellent quality. It sets quick, owing to its being nearly a pure carbonate. Mr. J. C. Brickley burns annually about 7,000 bushels, which hardly supplies the local demand. This industry might be much increased if the rock was quarried properly. Instead of taking a few loads from where it can be obtained the easiest, a quarry ought to be opened and worked below the surface of the river, and with a front not less than ten or twelve rods in length. When once opened, rock could be obtained with much less expense than at present, and if a

continual burner was used the cost of production would be much less. Not over two or three feet of stripping is required here, and that principally the alluvial deposits of the river. Although this rock is a magnesian limestone, the amount of magnesia present is much less than in rocks of the same age in Grant and Huntington counties.

The following analysis is taken from Prof. Cox's Report for 1878.

*Analysis of Rock at Macksville.*

Water expelled at 212° Fahr.....	1.18
Silicic acid.....	1.20
Ferrie oxide.....	1.30
Alumina.....	4.40
Lime.....	45.45
Magnesia.....	4.01
Carbonic acid.....	40.11
Sulphuric acid.....	.27
Loss and undetermined.....	2.08
Total.....	100.00

The principal ingredients of this rock, as seen from the above, are carbonate of lime, carbonate of magnesia and alumina. In calcining, probably the greater part of the magnesia is driven off, especially if a white heat is obtained. The strata here range from two to five inches in thickness, and though very soft when first taken from the quarry, become hard on exposure. In the upper layers, casts of *Pentamerus oblongus* are very abundant, many being nearly perfect; but as no pains had been taken to save the finest ones, only weathered specimens could be obtained. Impressions of an *Orthis* and *Spirifer* were observed, and, judging from the description given, *Orthoceras annulatum* and *Platystoma niagarensis* have been occasionally met with. The direction and amount of dip could not be determined. A small exposure occurs in section 8, West River township, range 13 east, 19 north, on Cabin creek, which was worked for lime, on a small scale, some years ago. No outcrop can be seen at present.

Near Ridgeville the rock is exposed along the Mississinewa riven for about two miles. Here is found about six feet of a

whitish, coarse-grained limestone which, though soft and friable when first taken from the quarry, hardens on exposure, and forms the principal stone used in the vicinity for walls and building. The strata range from two to four inches in thickness. This stone makes excellent lime, though none is being burnt at present. This rock differs very little from that at Macksville, as can be seen from the following analysis from the Indiana Geo. Report 1878.

*Analysis of Rock at Ridgeville.*

Water expelled at 212° F.....	0.90
Silicic acid.....	.70
Ferric oxide.....	2.70
Alumina.....	3.75
Lime.....	45.08
Magnesia.....	4.36
Carbonic acid.....	40.21
Sulphuric acid.....	.44
Loss and undetermined.....	1.86
<hr style="width: 10%; margin-left: auto;"/>	
Total.....	100.00

The presence of iron in the upper layers causes them to turn rusty or yellowish red upon exposure to the air, the oxide becoming a sesquioxide. Numerous impressions of fossils were seen. Corals of the genus *Favosites* were numerous, but good specimens could not be obtained. The more common of the fossils found are *Favosites niagarensis*, *F. favosus*, *Strophomena rhomboidalis*, *S. striata*, *Orthis elegantula*, *Pentamerus oblongus*, *P. sp.?* *Cladopora reticulata*, *Zaphrentis bilateralis*, *Meristina nitida* and *Platyostoma niagarensis*. West of Fairview, near the river, rock is found about two feet below the surface. This differs in no particular from that at Ridgeville, except that the strata are thicker. Only a small amount has been quarried. At neither of these localities could the dip be determined. The rocks of this county differ from that found in Delaware county in the absence of the argillaceous and cherty layers, as well as the more durable and desirable blue stone. The dip in Delaware county being to the southwest, the rock there belongs higher in the series. The difference is not due to a change in the litho-

logical character of the same strata, but to a change in the conditions under which they were deposited.

At the close of the Lower Silurian age the southern portion of that line of upheaval known as the Cincinnati arch was raised above the sea. In the continental ocean surrounding it was deposited the Niagara limestone, the most extensive of any of the formations subsequent to the Lower Silurian. The Cincinnati arch, extending from Nashville, Tennessee, to a point between Toledo and Sandusky, Ohio, was a line of unequal disturbance, which finally culminated in the elevation of the whole arch above the ocean at the close of the Devonian age. This arch is not a single fold, but, as ably shown by Prof. J. S. Newberry, in the geological survey of Ohio, its northern portion consists of at least two distinct folds. During the deposition of the Niagara limestone around the Lower Silurian island, the sea was gradually retiring with the elevation of the arch, and the different portions of the Niagara group, following the retreating waters, were deposited successively further from the old shore line. To-day the most recently formed strata of the Niagara are probably found along the Wabash river, showing that there had been a gradual elevation of this portion of eastern Indiana, during the Niagara period. The dip of the strata is both to southwest and northwest.

The dip of the blue limestone of Delaware county is such that the strata, if continued into Randolph county, would overlap the whitish rock found here. This blue limestone, if traced to the northwest, is found to underlie the yellowish, massive limestone of Grant county, the probable equivalent of the Guelph, Cedarville, or Pentamerus limestone, which is found covered by the whitish limestone along the Wabash. The limestone of Jay is similar to that of this county, but in Wells county the blue limestone appears in the bed of the Wabash.

Above the Niagara group in Ohio, is the Salina, with its beds of gypsum, but if any of this formation was deposited in Indiana, it is either covered by the drift or has been removed by erosion. Immediately succeeding this is the water-lime (Lower Helderburg), which forms the surface rock over a large portion of Ohio, but gradually becomes thinner and disappears before reaching this portion of Indiana. It is possible that this formation may be covered by the drift in the northeastern part

of the State; but so far, where the Devonian is exposed with the Niagara, there has been no water-lime intervening, and the exposures are so numerous along the western border of the arch, that if ever deposited it would have been observed; so far no outcrop of water-lime is found in Indiana. The water-lime of the falls of the Ohio at Louisville, belongs to the Upper Helderberg of Devonian age.

The prevalence of rocks of the Niagara group over so large an extent of territory in this State, together with the absence of the water-lime and salina, indicates that this portion of the State was above the ocean, at the time of their deposition. There is no evidence to show that Randolph and Jay counties were covered by Devonian seas, although they may have been. It is possible, even probable, that investigation will show that the Cincinnati arch, north of the Ohio river, consists of three folds instead of two, and that the older one of these extended from the Lower Silurian island, west of north, far into Indiana.

This county is the highest in the State, because it forms part of the Cincinnati arch which is crossed by the gentle fold extending from Northeastern Ohio into Indiana; everywhere throughout its course it marks a high elevation, and where these two lines of disturbance—if they be such—cross, is found the highest point measured in Ohio and Indiana. The highest points do not necessarily coincide with the water-shed, for deep valleys were excavated through this ridge by the glacial streams, showing that its present relative altitude is of comparatively recent date.

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## ECONOMIC GEOLOGY.

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The soil of this county is its only genuine and real mine of wealth, and most bountifully has it responded to the labors of the husbandman. Although, with the exception of the prairies, the soil is for the most part a heavy clay, it has been enriched by the vegetable accumulations of ages. The clays being the debris of many different formations, contain all the elements necessary for a fertile soil. In the southwestern part of the

county the soil is somewhat sandy; the fields of wheat one can see here, show well the adaptability of the soil. North of White river, the soil is a heavy clay, with occasional patches of muck; but as all this portion admits of draining, but little difference could be seen as regards the prospects of a bountiful harvest. Wheat, corn and grass are the principal productions, and if the prospects for this year are a criterion from which to judge, few counties in the State will have better cause to feel proud of their crops of wheat and grass. Some complaint was heard that the wheat was turning to chaff, but the real difficulty is that the farmer sowed chaff instead of wheat, and now, as harvest is near at hand, he tries to shirk the responsibility by claiming his misfortune to be due to a freak of nature, rather than to the proper cause—his own carelessness—as wheat never turns to chaff, nor chaff to timothy.

In the southern part of the county the prairies and the clays of the high lands are about equally divided, giving more variety of soil than is found in the northern part. All this portion admits of easy drainage, and the farmers are fast learning that labor expended in ditching is repaid many fold. The prairies and tracts of muck are well adapted to corn and wheat, while the clays, in addition, produce heavy crops of grass. Many fields will yield from two to three tons of hay per acre. Blue grass (*Poa pretensis*), is the most abundant of the native grasses, but timothy (*Phleum pratense*), grows equally well.

It must not be supposed that, however fertile a soil, it will continue to produce abundant harvests unless some effort is made to supply that waste of plant food which is lost with every crop harvested. Rotation of crops is a help to prolong the fertility of the soil; but as every crop of grass, corn stalks or straw, removes some of the silica, potash, lime and phosphates, this waste will have to be supplied if the soil is expected to produce with its usual degree of fertility.

Randolph is comparatively a new county, and the vegetable accumulation of ages is still present, but the time will come when this will disappear, as it is constantly exposed to atmospheric agencies, and then over a great part of the county will be found a stiff and unproductive clay. The loss of vegetable material can be supplied by turning under green crops of clover, weeds, corn stalks, etc., but the mineral loss must be replaced

by some of the many fertilizers. There has been very little need of the farmer paying much attention to this subject; but the time will come when the successful farmer will be the one who knows best how to supply to the soil the waste of mineral and vegetable material.

Over parts of the county log houses may still be seen, though they are fast disappearing before the increase in wealth and intelligence. Many fine farms, with their magnificent buildings, are monuments to the industry and intelligence of the people.

#### LIVE STOCK.

The county is well adapted to this industry, as the soil produces grass of a superior quality. Dairying would be a very profitable business here. Hogs are very numerous, and one of the sources of profit to the farmer. Mr. J. B. McKinney, of Franklin township, is the most extensive stock raiser, and his magnificent herd show what can be accomplished when care is taken in the selection of different breeds.

#### HORTICULTURE.

Fruits succeed tolerably well, though, owing to the climate, only the hardy varieties are profitable. Of grapes, the Concord is the best, as they ripen early. Of apples, Ben. Davis, Smith Cider, Roman Beauties and Maiden Blush, are the most hardy and profitable. The hills in the southern part of the county afford excellent localities for orchards. Many farmers have located their orchards in the black soil, making a mistake, as the trees do not thrive as well, and are more likely to be killed by cold winters. Mr. D. E. Hoffman, near Winchester, lost about 500 trees during the winter of 1880-'81.

A Horticultural Society has been organized, and its members are active workers. The officers are W. P. Murray, president, and J. P. Lesley, secretary.

#### BRICK AND TILE.

An abundance of good clay for brick and tile can be easily obtained. Many farmers, building brick houses, burn their own, calculating to sell enough, after using what they need,

to pay the expenses of the whole kiln. Tile kilns are numerous, but usually only enough is burned to supply the local demand. The Martin Brothers, of Winchester, Frist & Fickle, of Lynn, have the largest establishments in the county, and both ship tile to other localities. Nearly all the brick and tile made in the seventeen or eighteen factories are used in the county. This shows that the farmers are wide awake and appreciate the advantages to be derived from thorough drainage. But little has been done in underdraining the clay soils, most of the labor having been expended in redeeming the swamps.

#### MANUFACTORIES.

The most extensive establishments of this branch of industry are at Winchester and Union City. At the first named are the Bates Bros., flouring mill, one of the largest in the country; Kelley, Macy & Neff, handle factory; Fitz Maurice, foundry and machine shop; Adam Hirsh, planing mill; Stock Co. Wagon Works, Gen. Stone, president; D. E. Hoffman, marble works. At Union City are Peter Kentz, planing mill; Witham, Anderson & Co., planing mill; Union Carriage Manufacturing Co.; Hook Bro., butter-tub and pail works; Sam Carter, handle factory and trunk slats; J. W. Lambert & Co., handle factory. In both cities may be heard the busy hum of many smaller factories which, in the aggregate, are a great source of profit.

#### GRAVEL AND SAND.

Several of the roads leading to Winchester and Union City are pikes. Recently a system of free pikes has been established, and the county commissioners have in contemplation the building of more. Many of the cross roads ought to be graveled, as parts of the county are almost inaccessible during a portion of the year. Gravel and sand are plenty, and if, instead of turnpiking dirt roads, ditches were cut to let off the water, and the holes filled with gravel, it would be but a few years before all the roads would be nearly as good as pikes.

The careless manner that work is done on the roads, not only here, but in other counties as well, deserves condemnation. Instead of leaving the surface smooth and level, they are left in the worst condition possible; a scraper full here and there,



or the dirt is heaped up in the center of the road, leaving it for the horses and vehicles to wear down smooth. Roads worked in this manner are never good until after they have been worked over with the mud of the following winter and spring, whereas if properly finished they would soon become smooth and passable.

#### TIMBER.

The county was formerly heavily timbered, and much still remains. In the western part, oak, ash and beech are the prevailing kinds, while over the rest of the county, beech is the most common. Oak, ash and elm are plenty. Some of the elm attain gigantic proportions; maples are abundant in many localities; hickory and white wood (*Liriodendron tulipifera*), are found plenty in some parts, although most of the white wood has been shipped away. The many manufactories of the county are using a great amount of timber, and with care and judicious economy the supply will last for years.

#### ARCHÆOLOGY.

Evidences of a pre-historic race are abundant, and of such a character, in view of the magnitude of their works, that the observer experiences a feeling akin to reverence toward a mighty people, whose history is only written in their majestic ruins. In nearly every part those relics, as arrow-heads, axes, pestles, etc., have been found. From whence did they come? What their condition of life, their religion, and fate? are questions one intuitively asks when in the presence of their monuments of industry. The largest works of this ancient people are near Winchester, west of the confluence of Sugar creek with White river. It consists of a walled rectangular enclosure, with curved angles, 1,320 feet long, and 1,080 feet wide. Its area is thirty-one acres. Part of the south and west walls lie within the county fair grounds, the remainder in cultivated fields, and they are in a fair way to be entirely destroyed. On the eastern half of the south wall, which has never been disturbed, are

beech trees two feet in diameter. This part of the wall is the highest; and though it may have once been from eight to ten feet in height, it is now not over six feet. In the center of the enclosure is a circular mound one hundred feet across, and about eight feet high. Excavations have been made seven or eight feet in depth, both from the sides and summit, but nothing has ever been found. The east and west walls each have, near their middle, an opening, or gateway. The one on the east is unprotected, but the west one formerly had an embankment in the form of a half circle, which overlapped the gateway. No trace of this remains at present. The mound lies in a direct line between the two passage-ways. No evidence exists of a ditch either on the outside or inside.

Mr. John K. Martin, in removing part of the east wall, north of the opening, reports having found a number of holes about fifteen inches in diameter, and extending seven or eight feet below the summit of the wall. These, evidently, mark the position of posts, and show that the inclosure was further protected by a palisade. Just inside of the embankment, and about three feet from the surface, piles of ashes and charcoal are frequently met with. Their position indicates that they have been covered by the wash from the walls. No relics have been found. Nearly east from the northeast corner of the enclosure is a fine spring.

Southeast of the works along Sugar creek, the bluffs are sandy, and the Mound Builders probably used them for their burial ground, as many human skeletons have been exhumed while digging for gravel. The absence of all implements of warfare shows that this inclosure was not occupied for any length of time as a fortification but as a permanent residence. The streams are small and the bluffs low. Had the inclosure included the spring, the supposition that it was for protection, would have been more probable. It is not unlikely that this was a place for holding council or religious ceremonies. In section 23, range 14 east, Washington township, is a large, circular mound, which, although now somewhat reduced in size, could not have formerly been less than fifteen feet high and one hundred feet in diameter. In section 33, same township, is another, which measured three hundred feet in circumference and fifteen feet high; this was better preserved than the former.

Small bowlders were observed on the summit and sides. No excavations have been made in either of these mounds. Both were evidently built of clay taken from the immediate vicinity. They may have served as points of out-look, as they are only about one mile apart. In section 4, one mile southwest of the one last described, is a very large mound which is considered artificial by the people in that vicinity; but its relation to some small streams suggested that it was more likely one of nature's carving. On the map is marked its location, as future investigations may possibly show that it really belongs with the works of the Mound Builders.

In section 28, range 12 east, 20 north, Stony Creek township, between Stony creek and White river, is a large mound now covered with small oak trees. This is nearly circular, fifteen feet high, 150 feet in diameter. Excavations show that it is composed of clay mixed with charcoal and ashes. At the depth of nine feet a skeleton was found; beneath it was a pile of stone two feet high and three feet in diameter. Mr. Thompson, on whose farm this is situated, has quite a collection of implements found in this vicinity.

In section 10, range 13 east, 2 north, Franklin township, was a circular inclosure, with an area of about one and a half acres. The walls were four feet high. Although when first noticed by the earlier settlers it was in a good state of preservation, it has been destroyed, and no trace of it remains.

North of the Mississinewa river, between Ridgeville and Fairview, are a number of small tumuli, which contain ashes and charcoal. These may have been built by the Indians, as this used to be their camping ground.

Many of the gravel banks have served for the Indians as burial places, as skeletons are frequently met with while digging gravel for pikes. Some of the skeletons were of large size, and deposited with them were articles of ornament, as paint shells, etc. The position of some indicate that they had been buried in a sitting posture.

#### THANKS.

Acknowledgements are due to the citizens generally, as they have freely given all the assistance within their power. Thanks are especially due to Prof. W. H. Bowers, of Winchester, for

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his valuable assistance; to John Commons, Jr., Prof. Tucker, Hon. Nathan Chadwalder; the County Commissioners; D. E. Hoffman, Judge Monks and Prof. Boltz, of Ridgeville College; Hon. Thomas M. Browne, for valuable government reports, etc., and to Col. Moore, of Indianapolis, for table of altitudes of points on the I. B. & W. R. R.

CATALOGUE  
OF THE  
FLORA OF CENTRAL-EASTERN INDIANA.

(Alpine, or Elevated, District of the State.)

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By A. J. PHINNEY, M. D.

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*Prof. John Collett, State Geologist:*

DEAR SIR—I have the pleasure of herewith presenting a catalogue of the plants of Central-Eastern Indiana, embracing the counties of Delaware, Randolph, Jay and Wayne. Delaware county having been most thoroughly worked up, furnished by far the greatest number of species. Great care has been taken in the identification of species which are not contained in Coulter & Barnes' catalogue of the whole State. The list here given is, in great part, the result of three seasons' work, the species from Delaware county numbering 720. The grasses and sedges have all been identified by myself, and although the list is not large, the labor has been great, as they are by far the most difficult genera of our flora.

I take this opportunity to express my thanks to those who have kindly aided me in this work, and without whose assistance this catalogue would have been far from complete. President Moore, of Earlham College, Richmond, Indiana, furnished a list of 178 species, from the vicinity of Richmond, Wayne county, and Mrs. Mary P. Haines, of Richmond, kindly revised her list of ferns, many of which are not found in Delaware

county. Rev. D. S. McCaslin, has rendered efficient aid, both in Delaware and Jay counties, much of the accuracy claimed for this catalogue being due to his skill.

Respectfully,

A. J. PHINNEY.

Muncie, Ind., Sept. 15, 1882.

#### REMARKS.

The following catalogue embraces all plants except the non-vascular cryptogams. Many here named are without medicinal or economic value, and are looked upon as "weeds" by the farmer, and are of interest only to the scientist, yet they have a lesson to impart and a place to fill in the economy of nature.

This region is not characterized by any great variety of soils or physical conditions, which mark so many counties of the State. When this territory was first settled there were many small lakes, principally in the valleys of the ancient rivers, which have all been drained, destroying the greater part of the aquatic plants. Those which remain are confined to the swamps and borders of streams, and to-day we find none of the clear lakes, sandy barrens and extensive prairies of the northern part of the State; nor the extensive river bottoms, hills, prairies, barrens, rocky bluffs, lagoons and ponds, so characteristic of the lower Wabash; none of those ravines, where in the cool shade, and under dripping water, still linger the natives of a colder clime; none of those warm valleys which invite plants from their home in the south; no streams to bring us plants from other regions. In place of all these, this section of the State has a soil of clay, with a limited number of sandy and gravel ridges and many small prairies, nearly all under cultivation; so that the primitive vegetation is confined to the fence rows and swamps, or woody tracts which are protected from the cattle and swine.

The altitude of this region is the highest in the State, constituting, as Prof. Collet~~t~~ remarked, "the alpine region of Indiana." The streams flow in every direction from its summit, and serve to distribute its flora over nearly every part of the State south of the Wabash river. Although a great portion of the plants mentioned in the catalogue are common to every

county, yet, as a whole, there is a marked contrast with other portions of the State. Its altitude, ranging from 900 to 1,285 feet above the ocean, has given this region none of that tincturing of southern types so common in the valleys of our larger rivers, and its soil is not adapted to the growth of many species which are abundant in portions of Ohio, having the same altitude. One noticeable feature, is the absence of entire families which are well represented in other portions of the State. Of the *Ericaceæ*, or Heath Family, including the Huckleberry, Blueberry, Trailing Arbutus, Wintergreen, Laurel, Pipsissewa, etc., there are only two representatives, the Indian Pipe (*Monotropa uniflora*) which is very rare, having been found but once, and the Swamp Huckleberry (*Vaccinum macrocarpon*). As nearly all this family are natives of rocky woods, peat bogs or swamps, their absence is easily explained by what has been said of the physical conditions present here. The *Naiadaceæ* (Pondweed Family), immersed aquatics, have all been exterminated by the draining of the shallow lakes and swamps. The *Orchidaceæ* (Orchid Family), have yielded so far only two species, *Orchis spectabilis* and the Fringed Orchis. The other genera of this family have apparently all disappeared. Species of *Cypripedium* are said to have been plenty when the country was first settled. Of the *Coniferaæ* (Pine Family), there is not a single representative. The *Compositæ*, the largest family represented, has furnished over 100 species, or nearly one-seventh of the whole flora. The *Cyperaceæ*, although a very large family, gave only four genera, *Cyperus*, *Eleocharis*, *Scirpus* and *Carex*. The last named are usually known as the "wild grasses," though very distinct from that family. They have very little value, as they are eaten by cattle only when everything else fails. They may be known by their triangular stems (culms), rough leaves and spikes of fruit at the end of the stems. Some of them flower early in the spring and summer, much earlier than the true grasses, and all grow principally in swamps and wet meadows. Of Ferns, Wayne furnishes many that are not found in other counties. The Sensitive Fern, Maidenhair, Spleenworts, Wood-Ferns and Moonworts are the most common. The *Equisetaceæ* (Horse-Tail Family), are represented by two species, *E. hyemale* and *E. arvense*, the former being the tall "scouring rush" with which most are familiar. The Grasses are the most interesting and

one of the most valuable families found here. "This class of plants probably contribute more to the sustenance of man and beasts than all others combined." No poisonous or suspicious herb is found among them (with the exception of the poisonous darmel), in this respect being very unlike the Parsley Family (*Umbelliferæ*) and Night-Shade Family (*Solanaceæ*), every one of which are suspicious when growing wild. Many of the last named family, when cultivated, form valuable articles of food, *e. g.*, the Potato and Tomato. Through Prof. Brayton I learn that the time of flowering for the same species is two weeks later here than in Marion county, this being due to the greater elevation of this region, 200 to 500 feet. I have given the common names of most of the plants as they will be more intelligible to those who are not botanists.

## THANKS.

I desire to express my obligations to Prof. John M. Coulter, of Crawfordsville, for reviewing and correcting the mistakes in nomenclature and the identification of new species in my catalogue of plants, thus greatly enhancing the value of the catalogue.

DR. A. J. PHINNEY.



# CATALOGUE.

## RANUNCULACEÆ.

- CLEMATIS** *Viorna*, L. Leather-flower. Common. July.  
*Virginiana*, L. Virgin's Bower. Rare. July, August.  
*verticillaris*, DC. ? Found but once, in an immature state.
- ANEMONE** *Virginiana*, L. Common. July.  
*dichotoma*, L. (*A. Pennsylvanica*, L.) Common. June.  
*nemorosa*, L. Wind-flower. Common. May.  
*acutiloba*, Lawson. , (*Hepatica acutiloba*, DC.) Liver-leaf. Common. April, May. *A. hepatica*, L., (*H. triloba*, Chaix.) only grows east.
- THALICTRUM** *anemonoides*, Mich. Rue-anemone. Common. April, May.  
*dioicum*, L. Early Meadow-rue. Common. April, May.  
*purpurascens*, L. Purple Meadow-rue. Common. May, July.  
*purpurascens*, var. *ceriferum*, Austin. Rare. June.  
*Cornuti*, L. Tall Meadow-rue. Common. June, July.
- RANUNCULUS** *aquatilis*, L., var. *trichophyllus*, Gr. Water Crow-foot. Common. May, June.  
*aquatilis*, var. *stagnatilis*, DC. (*R. divaricatus*, Schk.) Still-water Crowfoot. Ponds. Rare. July.  
*multifidus*, Ph. Yellow Water Crowfoot. Rare. Swamps. June.  
*ambigens*, Watson. (*R. alismæfolius*, Geyer.) Water Plantain, Spearwort. Rare. July.

- abortivus*, L. Small-flowered Crowfoot. Common.  
April, May.
- abortivus*, var. *micranthus*, Gr. Buttercups. Rare.  
May.
- recurvatus*, Poir. Hooked Crowfoot. Swamps. Com-  
mon. June.
- Pennsylvanicus*, L. Not common. June.
- repens*, L. Creeping Crowfoot. Common. Wet  
grounds. June.
- bulbosus*, L. Bulbous C. Buttercups. Wayne county.  
Rare. June.
- ✓*CALTHA palustris*, L. Marsh Marigold. Common. Swamps.  
May.
- AQUILEGIA Canadensis*, L. Wild Columbine. Common. Dry  
fields. May, June.
- DELPHINIUM exaltatum*, Ait. Tall Larkspur. Wayne county.  
*tricorne*, Mich. Dwarf Larkspur. Rare. May.  
*azureum*, Mich. Azure Larkspur. Wayne county.  
*Consolida*, L. Field Larkspur. Common. Escaped  
from gardens. July.
- HYDRASTIS Canadensis*, L. Golden Seal. Yellow Puccoon. Com-  
mon. May.
- ACTÆA spicata*, L., var. *rubra*, Mich. Red Baneberry. Rare.  
May.
- alba*, Bigel. White Baneberry. White Cohosh. Com-  
mon. May

MAGNOLIACEÆ.

- MAGNOLIA acuminata*, L. Cucumber Tree. Randolph county.  
Rare.
- LIRIODENDRON Tulipifera*, L. White Wood. Common. June.

ANONACEÆ.

- ASIMINA triloba*, Dunal. Papaw. Rare.

MENISPERMACEÆ.

- MENISPERMUM Canadense*, L. Moonseed. Common. July, Au-  
gust.

## BERBERIDACEÆ.

- BERBERIS *vulgaris*, L. Common Barberry. Wayne county.  
 CAULOPHYLLUM *thalictroides*, Mich. Pappoose Root. Blue Co-  
 hosh. Common.  
 JEFFERSONIA *diphylla*, Pers. Twin Leaf. Common. April,  
 May.  
 PODOPHYLLUM *peltatum*, L. Mandrake. Common. May, June.

## NYMPHÆACEÆ.

- NYMPHÆA *tuberosa*, Paine. Water Lily. Jay county.  
 NUPHAR *advena*, Ait. Yellow Pond-Lily. Common. Swamps.

## PAPAVERACEÆ.

- STYLOPHORUM *diphyllum*, Nutt. Yellow Poppy. Wayne county.  
 CHELIDONIUM *Majus*, L. Celandine. Rare. Escaped. Randolph  
 and Wayne.  
 SANGUINARIA *Canadensis*, L. Bloodroot. Common. April, May.

## FUMARIACEÆ.

- DICENTRA *Cucullaria*, DC. Dutchman's Breeches. Common.  
 April, May.  
     *Canadensis*, DC. Squirrel Corn. Common. April,  
 May.  
 FUMARIA *officinalis*, L. Common Fumitory. Wayne county.

## CRUCIFERÆ.

- NASTURTIUM *officinale*, R. Br. True Water-cress. Rare. Wet  
 places. July.  
     *palustre*, DC. Marsh Cress. Common. June.  
     *Armoracia*, Fries. Horseradish. Escaped from culti-  
 vation.  
 DENTARIA *laciniata*, Muhl. Pepper-root. Common. April,  
 May.

- CARDAMINE *rhomboidea*, DC. Spring Cress. Common. May.  
*rhomboidea*, var. *purpurea*, Torr. Common. May.  
*hirsuta*, L. Small Bitter Cress. Common. June.
- ARABIS *dentata*, T. & G. Rock Cress. Common. June.  
*lævigata*, DC. Rock Cress. Wayne county.  
*Canadensis*, L. Sickle-pod. Wayne county.
- THELYPODIUM *pinnatifidum*, Wats. (*Arabis hesperidoides*, Gray). Common.
- BARBAREA *vulgaris*, R. Br. Winter Cress. Common.
- SISYMBRIUM *officinale*, Scop. Hedge Mustard. Common. Waste places.
- BRASSICA *nigra*, Koch. Black Mustard. Common. Waste places.
- CAPSELLA *Bursa-pastoris*, Mönch. Shepherd's Purse. Common everywhere.
- LEPIDIUM *Virginicum*, L. Wild Peppergrass. Common. June, August.  
*sativum*, L. Peppergrass. Escaped. Wayne county.

## VIOLACEÆ.

- IONIDIUM *concolor*, Benth. & Hook. Green Violet. Wayne county.
- VIOLA *cucullata*, Ait. Common Blue Violet. Common. May to July.  
*sagittata*, Ait. Rare. Sandy hillsides. May.  
*delphinifolia*, Nutt. (Larkspur V.) Wayne county.  
*pedata*, L. (Bird-foot V.) Wayne county.  
*striata*, Ait. (Pale V.) Common. April, May.  
*Canadensis*, L. (Tall V.) Common. Woods. June.  
*pubescens*, Ait. (Yellow V.) Common. Fields and woods. June.

## HYPERICACEÆ.

- HYPERICUM *perforatum*, L. Common St. John's-Wort. Rare. Meadows. August.  
*corymbosum*, Muhl. Common St. John's-Wort. Rare. Meadows. August.

## CARYOPHYLLACEÆ.

- SAPONARIA officinalis*, L. Bouncing Bet. Soapwort. Common.  
Around dwellings.
- SILENE stellata*, Ait. Starry Campion. Common. Woods. July.  
*nivea*, DC. Starry Campion. Rare.  
*Virginica*, L. Fire Pink. Catchfly. Common. June.  
*regia*, Sims. Royal Catchfly. Wayne.  
*noctiflora*, L. Night Flowering Catchfly. Rare.  
Escaped.
- LYCHNIS Githago*, Lam. Wheat Cockle. Common. Wheat-  
fields.
- ARENARIA lateriflora*, L. Sandwort. Common. Moist woods.
- STELLARIA media*, Smith. Common Chickweed. Common.  
April to July.  
*pubera*, Mich. Great Chickweed. Wayne.  
*longifolia*, Muhl. Long-leaved Stitchwort. Rare. Wet  
places. June.
- CERASTIUM vulgatum*, L. Mouse-ear Chickweed. Common.  
April, May.  
*viscosum*, L. Large Mouse-ear Chickweed. June.  
Randolph.  
*nutans*, Raf. Mouse-ear Chickweed. Rare. May.
- SAGINA apetala*, L.? Pearlwort. Rare. May.

## PORTULACACEÆ.

- PORTULACA oleracea*, L. Purslane. Common. Cultivated fields.
- CLAYTONIA Virginica*, L. Spring Beauty. Common. Moist  
woods.

## MALVACEÆ.

- MALVA rotundifolia*, L. Common Mallow. Common around  
dwellings.  
*Moschata*, L. Musk Mallow. Rare. Roadsides.
- MALVASTRUM angustum*, Gray. False Mallow. Rare. August.  
Dry grounds. Distinguished from *Sida* by its  
notched petals.

*SIDA spinosa*, L. Sida. Rare. Moist grounds. September.

*ABUTILON Avicennæ*, Gærtn. Indian Mallow.

*HIBISCUS Trionum*, L. Bladder Ketmia. Rare. Roadsides.  
August.

### TILIACEÆ.

*TILIA Americana*, L. Basswood. Common. Woods.

*heterophylla*, Vent. White Basswood. Rare. Wayne.

### LINACEÆ.

*LINUM usitatissimum* L. Common Flax. Escaped.

### GERANIACEÆ.

*GERANIUM maculatum*, L. Wild Cranesbill. Common. Woods.  
May.

*Carolinianum*, L. Carolina Cranesbill. Rare. Meadows.

*IMPATIENS pallida*, Nutt. Pale Touch-me-not. Common.  
July, August.

*fulva*, Nutt. Spotted Touch-me-not. Common. July,  
August.

*OXALIS corniculata*, L., var. *stricta*, Sav. (*O. stricta*, L.) Yellow  
Sheep-sorrel. Common. Fields. June.

*violacea*, L. Violet sorrel. Rare. Dry woods. May.

*FLORÆA proserpinacoides*, Willd. False Mermaid. Damp  
woods. May.

### RUTACEÆ.

*XANTHOXYLUM Americanum*, Mill. Prickly Ash. Common.  
Woods.

*PTELEA trifoliata*, L. Hop tree. Common. Woods and along  
streams.

### SIMARUBACEÆ.

*AILANTHUS glandulosus*, Desf. Rare. Jay county.

## ANACARDIACEÆ.

- RHUS *typhina*, L. Staghorn Sumach. Wayne.  
*glabra*, L. Smooth Sumach. Common. Fence rows.  
*Toxicodendron*, L. Poison Ivy. Three-leaved Ivy.  
 Rare.

## VITACEÆ.

- VITIS *Labrusca*, L. Fox Grape.  
*estivalis*, Mich. Summer Grape.  
*cordifolia*, Mich. Frost Grape.  
*indivisa*, Willd.  
 AMPELOPSIS *quinquefolia*, Mich. Five-leaved Ivy. Virginia  
 Creeper.

## RHAMNACEÆ.

- RHAMNUS *cathartica*, L. Buckthorn. Wayne.  
 CEANOTHUS *Americanus*, L. Jersey Tea. Common. Dry  
 woods. July.

## CELASTRACEÆ.

- CELASTRUS *scandens*, L. Climbing Bitter-sweet. Common.  
 Woods.  
 EUONYMUS *atropurpureus*, Jacq. Waahoo. Burning Bush.  
 Rare.  
*Americanus*, var. *obovatus*, T. & G. Strawberry Bush.

## SAPINDACEÆ.

- STAPHYLEA *trifolia*, L. Bladder-nut. Wayne.  
 ÆSCULUS *glabra*, Willd. Buckeye. Common. Woods.  
 ACER *saccharinum*, Wang. Sugar Maple. Common. Woods.  
*saccharinum* var. *nigrum*, T. & G. Black Maple. Com-  
 mon. Woods.  
*dasycarpum*, Ehr. Silver Maple. Common as shade-  
 trees.  
*rubrum*, L. Red Maple. Common. Swamps.  
 NEGUNDO *aceroides*, Mœnch. Box Elder. Rare. River bottoms.

## POLYGALACEÆ.

*POLYGALA Senega*, L. Seneca Snakeroot. Rare. Dry ground.  
June.

## LEGUMINOSÆ.

*TRIFOLIUM pratense*, L. Red Clover. Common. Meadows.  
May.

*repens*, L. White Clover. Common. Fields. May.

*agrarium*, L. Yellow Hop Clover. Rare. Randolph.  
July.

*procumbens*, L. Low Hop Clover. Rare. Roadsides.

*MELILOTUS alba*, Willd. White Sweet Clover. Around dwell-  
ings.

*PSORALEA Onobrychis*, Nutt. Rare. Dry grounds.

*melilotoides*, Mich. Common. Woods.

*PETALOSTEMON violaceus*, Mich. Prairie Clover. Rare. Dry  
hillsides.

*ROBINIA Pseudacacia*, L. Common Locust. Cultivated.

*WISTARIA frutescens*, DC. Rare. Jay county. August.

*ASTRAGALUS Canadensis*, L. Milk Vetch. Rare. Woods.

*DESMODIUM nudiflorum*, DC. Tick-Trefoil. Common. Rich  
woods. August.

*acuminatum*, DC. Common. Rich woods. August.

*pauciflorum*, DC. Rare. Rich woods. August.

*rotundifolium*, DC. Rare. Rich woods. September.

*canescens*, DC. Rare. Rich woods. August.

*cuspidatum*, T. & G. Rare. Rich woods. August.

*sessilifolium*, T. & G. Rare. Rich woods. August.

*rigidum*, DC. Common. Rich woods. August.

*Marylandicum*, Boott. Rare. Rich woods. August.

*LESPEDEZA repens*, T. & G. Bush clover. Common. Rich woods.  
August.

*reticulata*, Pers. (*L. violacea*, var. *sessiliflora*, Gr.)  
Bush clover. Common. Dry hill sides. Au-  
gust.



- APIOS tuberosq*, Mœnch. Wild Bean. Rare. Rich ground. August.
- AMPHICARPÆA monoica*, Nutt. Hog Peanut. Common. Woods. Sometimes with pure white flowers.
- BAPTISIA leucantha*, T. & G. False Indigo. Not common. July.
- GALACTIA glabella*, Mich. Milk Pea. Rare. Rich woods. August.
- CERCIS Canadensis*, L. Red-Bud. Common. Woods. April, May.
- CASSIA Marylandica*, L. Wild Senna. Common. July.  
*Chamæerista*, L. Wild Senna. Rare. July.  
*nictitans*, L. Wild Sensitive Plant. Rare. July.
- GYMNOCLADUS Canadensis*, Lam. Coffee Tree. Not rare.
- GLEDITSCHIA triacanthos*, L. Three-Thorned Acacia. Honey-Locust. Common.

### ROSACEÆ.

- PRUNUS Americana*, Marsh. Red Plum. Common. Woods.  
*Pennsylvanica*, L. Wild Red Cherry. Rare. Woods.  
*Virginiana*, L. Choke Cherry. Common. Fence rows.  
*serotina*, Ehr. Wild Black Cherry. Common. Woods.
- NEILLIA opulifolia*, Benth. & Hook. (*Spiræa opulifolia*, L.)  
 Nine-bark. Wayne.
- SPIRÆA salicifolia*, L. Common Meadow-sweet. Low grounds. July.  
*lobata*, Jacq. Queen of the Prairie. Common. Prairies.
- AGRIMONIA Eupatoria*, L. Agrimony. Common. Woods. July.  
*parviflora*, Ait. Small Flowered Agrimony. Common. Woods.
- GEUM album*, Gmel. Avens. Common. Moist grounds. July.  
*virginianum*, L. Common. Moist grounds. July.  
*vernum*, T. & G. Common. Moist grounds. May.

- POTENTILLA** *Norvegica*, L. Five-finger. Cinque-foil. Rare.  
*Canadensis*, L. Common Cinque-foil. Five-finger.  
 Common.  
*Canadensis*, var. *simplex*, T. & G. Five-finger. Com-  
 mon.
- FRAGARIA** *Virginiana*, Ehr. Strawberry. Common. May.
- RUBUS** *strigosus*, Mich. Wild Red Raspberry. Rare.  
*occidentalis*, L. Black Raspberry. Common.  
*villosus*, Ait. High Blackberry. Common.  
*Canadensis*, L. Dewberry. Common.
- ROSA** *setigera*, Mich. Climbing Prairie Rose. Common.  
*Carolina*, L. Swamp Rose. Common.  
*parviflora*, Ehrh. (*R. lucida*, Ph.) Dwarf Wild Rose.  
 Common.  
*nitida*, Willd. Wayne county.
- CRATÆGUS** *coccinea*, L. Black Thorn. Common. May.  
*tomentosa*, L., var. *punctata*, Gray. Thorn. Com-  
 mon.  
*subvillosa*, Schrad. Thorn. Common.  
*Crus-galli*, L. Cockspur Thorn. Common. May.
- PIRUS** *coronaria*, L. Wild Crab-apple. Common. Woods.  
*arbutifolia*, L. Choke-berry.
- AMELANCHIER** *Canadensis*, T. & G. Shad Bush. Rare. Jay  
 county.

SAXIFRAGACEÆ.

- RIBES** *Cynosbati*, L. Wild Gooseberry. Common. Woods. May.  
*floridum*, L'Her. Wild Black Currant. Rare. May.
- HYDRANGEA** *arborescens*, L. Wild Hydrangea. Wayne county.
- SAXIFRAGA** *Pennsylvanica*, L. Swamp Saxifrage. Common.  
 Swamps. May.
- HETUCHERA** *Americana*, L. Common Alum-root. Common.  
 Moist, rich grounds.

*MITELLA diphylla*, L. Mitre-wort. Bishop's Cap. Common.  
In moss, in moist, rich grounds. May.

*TIARELLA cordifolia*, L. False Mitre-wort. Common. Rich  
woods.

### CRASSULACEÆ.

*PENTHORUM sedoides*, L. Ditch Stone-crop. Common. Ditches  
and wet places. July.

*SEDUM ternatum*, Mich. Stone-crop. Orpine. Rare. Rich woods.

### HAMAMELACEÆ.

*HAMAMELIS Virginiana*, L. Witch Hazel. Rare. Jay county.

### HALORAGEÆ.

*MYRIOPHYLLUM scabratum*, Mich. Water Milfoil. Rare.  
Ponds. August.

*ambiguum*, Nutt? Water Milfoil. Rare. Ponds.  
August.

### ONAGRACEÆ.

*CIRCÆA Lutetiana*, L. Enchanter's Nightshade. Common. Rich,  
damp woods.

*alpina*, L. Tall Enchanter's Nightshade. Common.  
Rich, damp woods.

*GAURA biennis*, L. Gaura. Rare. Fields and woods.

*flipes*, Spach. Common. Fields and woods.

*EPILOBIUM coloratum*, Muhl. Willow-herb. Common. Rich  
woods and fields. August.

*CENOTHERA biennis*, L. Common Evening Primrose. Common.  
August.

*fruticosa*, L. Sundrops. Rarer than the last. August.

*LUDWIGIA alternifolia*, L. Loosestrife. Rare. Swamps. Jay  
county. August.

*polycarpa*, Short & Peter. Loosestrife. Rare. Swamps.  
August.

*palustris*, Ell. Loosestrife. Common. Swamps. August.

## LYTHRACEÆ.

LYTHRUM *alatum*, Pursh. Loosestrife. Common. Prairies.  
August.

## CUCURBITACEÆ.

SICYOS *angulatus*, L. One-seeded Star-cucumber. River banks.  
July.

ECHINOCYSTIS *lobata*, T. & G. Wild Balsam-apple. Rich soils.  
July.

## UMBELLIFERÆ.

SANICULA *Canadensis*, L. Sanicle. Black Snakeroot. Common.  
Rich woods. July.

DAUCUS *Carota*, L. Common Carrot. Escaped. August.

HERACLEUM *lanatum*, Mich. Cow-parsnip. Rare. River banks.  
June.

PASTINACA *sativa*, L. Common Parsnip. Fields. June.

ARCHEMORA *rigida*, DC. Cow-bane. Rare. Swamps. August.

ARCHANGELICA *atropurpurea*, Hoffm. Great Angelica. Rare.  
River bottoms. Largest of the family four to  
eight feet high. Purple stems. Large com-  
pound leaves.

CONIOSELINUM *Canadense*, T. & G. Hemlock-parsley. Common.  
Swamps. August.

THASPIUM *barbinode*, Nutt. Meadow-parsnip. Common. Rich  
grounds. June.

*aureum*, Nutt. Meadow-parsnip. Common. Rich  
grounds. June.

*trifoliatum*, Gray. Meadow-parsnip. Common. Rich  
grounds. June.

PIMPINELLA *integerrima*, DC. Rare. Dry hillsides. May,  
June.

CICUTA *maculata*, L. Poison Hemlock. Spotted Cow-bane.  
Common. Swamps and wet grounds.

- SIUM cicutæfolium*, Gmelin. (*S. lineare*. Mx.) Water-parsnip.  
Rare. Swamps.
- CRYPTOTÆNIA Canadensis*, DC. Honewort. Common. Thick-  
ets. June.
- CHÆROPHYLLUM procumbens*, Lam. Chervil. Rare. River  
banks. May.
- OSMORRHIZA longistylis*, DC. Smoother Sweet Cicely. Com-  
mon. Moist woods. June.  
*brevistylis*, DC. Hairy Sweet Cicely. Common. Rich  
wood. June.
- ERIGENIA bulbosa*, Nutt. Harbinger of Spring. Common.  
Rich woods. April, May.

## ARALIACEÆ.

- ARALIA racemosa*, L. Spikenard. Common. Moist places.  
July.  
*quinquefolia*, D. & P. Ginseng. Common. Rich  
woods. July.

## CORNACEÆ.

- CORNUS florida*, L. Flowering Dogwood. Common. Woods.  
May.  
*circinata*, L'Her. Round-leaved Dogwood. Common.  
Swamps. June.  
*sericea*, L. Silky Cornel. Kinnikinnik. Common.  
Swamps. June.  
*stolonifera*, Mich. Red-osier Dogwood. Swamps.  
June.  
*paniculata*, L'Her. Panicked Cornel. Common.  
Thickets. June.  
*alternifolia*, L. Alternate-leaved Cornel. Wayne  
county.
- NYSSA multiflora*, Wang. Pepperidge. Sour Gum. Rare.  
Woods.

## CAPRIFOLIACEÆ.

- LONICERA *'sempervirens*, Ait. Trumpet Honeysuckle. Wayne county.
- flava*, Sims. Yellow Honeysuckle. Rare. Randolph county. June.
- TRIOSTEUM *perfoliatum*, L. Horse-Gentian. Common. Fields. June, July.
- SAMBUCUS *Canadensis*, L. Common Elder.
- VIBURNUM *prunifolium*, L. Black Haw. Common. Woods. May.
- dentatum* L. Arrow-wood. Rare. Wet places. June.
- pubescens*, Pursh. Downy Arrow-wood. Common. Fence rows. July.
- acerifolium*, L. Maple-leaved Arrow-wood. Common. Woods. June.

## RUBIACEÆ.

- GALIUM *aparine*, L. Cleavers. Goose-grass. Common. Rich woods. May.
- asprellum*, Mich. Rough Bedstraw. Low thickets. May.
- concinnum*, T. & G. Bedstraw. Rare. Rich woods. July.
- trifidum*, L. Small Bedstraw. Rare. Moist woods. June.
- var. *pusillum*, Gr. Bedstraw. Rare. Moist woods. June.
- var. *latifolium*, Gr. Bedstraw. Rare. Moist woods. June.
- pilosum*, Ait. Bedstraw. Common. Moist woods. July.
- circæzans*, Mich. Wild Liquorice. Common. Moist woods. July.
- CEPHALANTHUS *occidentalis*, L. Button-bush. Common. Swamps. August.
- MITCHELLA *repens*, L. Partridge-berry. Rare. Dry woods. June.

*HOUSTONIA purpurea*, L. Bluets. Common. Dry grounds. May.  
var. *longifolia*, Gray. Common. Dry grounds.  
June.

## VALERIANACEÆ.

*FEDIA radiata*, Mich. Lamb-Lettuce. Common. Wet places.  
June.

## DIPSACEÆ.

*DIPSACUS sylvestris*, Mill. Wild Teasel. A nuisance in pas-  
tures. August.

## COMPOSITÆ.

*VERNONIA Noveboracensis*, Willd. Iron-weed. Pastures. Au-  
gust.

*fasciculata*, Mich. Iron-weed. Common form. Some-  
times with white flowers.

*EUPATORIUM purpureum*, L. Joe-Pye Weed. Queen of the  
Meadow. Common. August.

*altissimum*, L. Fall Boneset. Rare. Dry grounds.  
August.

*sessifolium*, L. Upland Boneset. Common. Dry grounds.  
August.

*perfoliatum*, L. Boneset. Common. Wet places. Au-  
gust.

*ageratoïdes*, L. White Snake Root. Common. Dry  
grounds. August.

*ASTER patens*, Ait. Rare. Dry woods. August, September.

*cordifolius*, L. Common. Dry woods. August, Sep-  
tember.

*dumosus*, L. Common. Dry woods. August, Septem-  
ber.

*Tradescanti*, L. Common. Moist ground. August,  
September.

*miscr*, L. Common. Dry grounds. August, Septem-  
ber.

*simplex*, Willd. Common. Moist grounds. August,  
September.

- tenuifolius*, L. Common. Low grounds. August.  
*carneus*, Nees. Rare. Prairies. August, September.  
*punicus*, L. Common. Swamps. Low grounds. August.
- prenanthoides*, Muhl. Common. Rich woods. August, September.
- Novæ-Angliæ*, L. Common. Prairies. August, September.
- ERIGERON** *Canadense*, L. Horse-weed. Fleabane. Common. Dry fields. August.  
*bellidifolium*, Muhl. Fleabane. Common. May, June.  
*Philadelphicum*, L. Fleabane. Common. May, June.  
*annuum*, Pers. Daisy Fleabane. Nuisance in meadows. July.  
*strigosum*, Muhl. Daisy Fleabane. Nuisance in meadows. July.
- DIPLOPAPPUS** *umbellatus*, T. & G. Moist thickets. Jay county. September.
- BOLTONIA** *glastifolia*, L'Her. Resembles *B. diffusa* except in the larger heads. Diffusely branched. Rare. Prairies. September.
- SOLIDAGO** *bicolor*, L. Golden Rod. Common. Dry, rich woods and fields. August.  
*latifolia*, L. Golden Rod. Common. Moist woods. August.  
*cæsia*, L. Golden rod. Common. Dry, rich woods and fields. August.  
*Riddelli*, Frank. Golden Rod. Common. Prairies. August, September.  
*patula*, Muhl. Golden Rod. Common. Moist, rich woods and fields. August.  
*altissima*, L. Golden Rod. Common. Moist, rich woods and fields. August.  
*ulmifolia*, Muhl. Golden Rod. Common, Moist, rich woods and fields. August.  
*nemoralis*, Ait. Golden Rod. Common. Prairies. August.  
*Canadensis*, L. Golden Rod. Common. Fence rows. August.



- tenuifolia*, Pursh. Golden Rod. Common. Fence rows. August.
- INULA** *Helenium*, L. Elecampane. Common. Dry, rich grounds. July.
- SILPHIUM** *laciniatum*, L. Rosin-weed. Common. Prairies. August.
- terebinthinaceum*, L. Rosin-weed. Common. Prairies. August.
- integrifolium*, Mich. Rosin-weed. Common. Prairies. August.
- perfoliatum*, L. Rosin-weed. Common. Prairies. August.
- AMBROSIA** *trifida*, L. Great Rag-weed. Common. Waste places. July, August.
- var. *integrifolia*, Gray. Rag-weed. Rare. Waste places, July, August.
- artemisiæfolia*, L. Wormwood. Common, everywhere. July, August.
- XANTHIUM** *strumarium*, L. Cocklebur. Common. August.
- ECLIPTA** *procumbens*, Mich. Common. August.
- HELIOPSIS** *lævis*, Pers.
- var. *scabra*, Gray. Ox-eye. Rare. Copses. August.
- ECHINACEA** *purpurea*, Mœnch. Purple Cone-flower. Rare. Rich woods. July.
- RUDBECKIA** *laciniata*, L. Cone-flower. Common. Dry soils. August.
- triloba*, L. Cone-flower. Common. Dry soils. August.
- fulgida*, Ait. Cone-flower. Common. Dry soils. August.
- hirta*, L. Cone-flower. Common. Dry soils. August.
- LEPACHYS** *pinnata*, T. & G. Rare. August.
- HELIANTHUS** *annuus*, L. Wild Sunflower. Common. Prairies. August.
- rigidus*, Desf. Wild Sunflower. Meadows. June.
- lætiflorus*, Pers. Wild Sunflower. Common. Dry fields. July.

- microcephalus*, T. & G. Wild Sunflower. Prairies. July.
- giganteus*, L. Wild Sunflower. Moist grounds. August.
- grosse-serratus*, Martens. Wild Sunflower. Moist grounds. August.
- tomentosus*, Mich. Wild Sunflower. Moist grounds. August.
- strumosus*, L. Wild Sunflower. Moist grounds. August.
- hirsutus*, Raf. Wild Sunflower. Dry grounds. July, August.
- decapetalus*, L. ? Wild Sunflower. Moist grounds. August.
- doronicoides*, Lam. Wild Sunflower. Moist grounds. August.
- ACTINOMERIS** *squarrosa*, Nutt. Common. August.
- helianthoides*, Nutt. Common. August.
- COREOPSIS** *tripteris*, L. Tall Coreopsis. Tickseed. Common. August.
- trichosperma*, Mich. Tickseed Sunflower. Wet places. August.
- BIDENS** *frondosa*, L. Beggar-ticks. Spanish needles. Common. Wet places.
- connata*, Muhl. Spanish needles. Common. Moist grounds. August.
- cernua*, L. Spanish needles. Common. Moist grounds. July.
- chrysanthemoides*, Mich. Spanish needles. Common. Moist grounds. August.
- bipinnata*, L. Spanish needles. Common. Moist grounds. August.
- DYSODIA** *chrysanthemoides*, Lag. Fetid Marigold.
- HELENIUM** *autumnale*, L. Sneeze-weed. Common. August.
- LEPTOPODA** *brachypoda*, T. & G. Rare. August.
- ANTHEMIS** *Cotula*, L. (Maruta *Cotula*, L.) Mayweed. Dog Fennel. Common everywhere.

- ACHILLEA *Millefolium*, L. Yarrow. Common. Dry fields. July.
- LEUCANTHEMUM *vulgare*, L. Ox-eye Daisy. Common. Pastures. June.
- TANACETUM *vulgare*, L. Tansy. Common around dwellings.
- ARTEMISIA *biennis*, Willd. Wormwood. Rare. September.
- GNAPHALIUM *purpureum*, L. Purple Cudweed. Rare. September.
- ANAPHALIS (*Antennaria*) *margaritacea*, B. & H. Resembles the next only larger. July.
- ANTENNARIA *plantaginifolia*, Hook. Plantain-leaved Everlasting. Common. Old fields. May.
- EREC THITES *hieracifolia*, Raf. Fire-weed. Common. New fields. August.
- CACALIA *suavecolens*, L. Indian Plantain. Common. Wet places. August.
- atriplicifolia*, L. Indian Plantain. Common. Dry fields. July.
- SENECIO *aureus*, L. Golden Rag-wort. Squaw-weed. Common. Wet places. May.
- var. *obovatus*, Gray. Squaw-weed. Common. Wet places. May.
- CNICUS (*Cirsium*) *lanceolatus*, Hoffm. Common Thistle. Common everywhere. July.
- Virginianus*, Mich. Woolly Thistle. Rarer than the last.
- allissimus*, Willd. Fall Thistle. Rarer than the first.
- muticus*, Mich. Swamp Thistle. Common. Swamps.
- arvensis*, Scop. Canada Thistle. Rare.
- LAPPA *officinalis*, Allioni. Burdock. Common. July.
- CYNTHIA *Virginica*, Don. Rare. Woods. July.
- NABALUS *albus*, Hook. Common. Woods. Jay county.
- TARAXACUM *Dens-Conis*, Desf. Dandelion. Common everywhere.
- LACTUCA *Canadensis*, L. Wild Lettuce. Common. Pastures and woods. July.

- var. *integrifolia*, T. & G. Wild Lettuce. Common.  
Pastures and woods. July.  
*villosa*, Jacq. Blue Lettuce. Common. Pastures and  
woods.

*SONCHUS asper*, Vill. Spring-leaved Thistle. Common. Waste  
places. July.

### LOBELIACEÆ.

- LOBELIA cardinalis*, L. Cardinal Flower. Common. Rich, wet  
places. July.  
*syphilitica*, L. Great Blue Lobelia. Common. Wet  
ground. July, August.  
*puberula*, Mich. Great Blue Lobelia. Common. Wet  
places. July, August.  
*leptostachys*, D C. Great Blue Lobelia. Common.  
Wet places. July, August.  
*inflata*, L. Indian Tobacco. Common. Fields. July.

### CAMPANULACEÆ.

- SPECULARIA perfoliata*, D C. Venus Looking-glass. Common.  
Woods. July.  
*CAMPANULA Americana*, L. Tall Bell-flower. Common. Woods.  
July.

### ERICACEÆ.

- VACCINIUM macrocarpon*, Ait. Large Cranberry. Rare. Swamps.  
Jay county.  
*MONOTROPA uniflora*, L. Indian Pipe. Rare. Damp woods.

### ILICINEÆ (AQUIFOLIACEÆ).

- ILEX verticillata*, Gray. Black Alder. Common. Swamps.

### PRIMULACEÆ.

- DODECATHEON Meadia*, L. American Cowslip. Rare. Wet  
grounds.

- STEIRONEMA** (*Lysimachia*) *ciliatum*, L. Loosestrife. Common.  
Moist places. July.  
*lanceolatum*, Gray. Loosestrife. Common. Moist  
places. July.  
*longifolium*, Pursh. Common. Moist grounds. July.
- SAMOLUS** *Valerandi*, L., var. *Americanus* Gr. Water Pimpernel.  
Brook-weed. Ditches and swamps. August.

## OLEACEÆ.

- FRAXINUS** *Americana*, L. White Ash. A valuable tree.  
*quadrangulata*, Mich. Blue Ash. Rare.  
*sambucifolia*, Lam. Black Ash. Swamp Ash. Com-  
mon.

## APOCYNACEÆ.

- APOCYNUM** *androsæmifolium*, L. Spreading Dogbane. Dry soil.  
*cannabinum*, L. Indian Hemp. Common. Dry soil.

## ASCLEPIADACEÆ.

- ASCLEPIAS** *tuberosa*, L. Pleurisy-root. Dry soils. July.  
*purpurascens*, L. Purple Milkweed. Common. July.  
*incarnata*, L. Swamp Milkweed. Swamps. July.  
*Cornuti*, Decaisne. Common Milkweed. Very common.  
*phytolaccoides*, Pursh. Poke Milkweed. Rare.

## GENTIANACEÆ.

- GENTIANA** *crinita*, Frœl. Fringed Gentian. Wayne county.  
*Andrewsii*, Griseb. Closed Blue Gentian. Rare. Wet  
places.
- FRASERA** *Carolinensis*, Walt. American Columbo. Rich woods.  
July.

## POLEMONIACEÆ.

- PHLOX** *paniculata*, L. Pink Sweet William. Jay county. Au-  
gust.  
*maculata*, L. Pink Sweet William. Prairies. July.

- glaberrima*, L., var. *suffruticosa*, (*P. Carolina*). Pink Sweet William. Jay county. August.  
*divaricata*, L. Pink Sweet William. Common. Woods. May.

**POLEMONIUM** *reptans*, L. Jacob's Ladder. Greek Valerian. Common. Moist woods. May.

### HYDROPHYLLACEÆ.

**HYDROPHYLLUM** *macrophyllum*, Nutt. Water-leaf. Common. Woods. June.

*Virginicum*, L. Water-leaf. Common. Woods. June.

*appendiculatum*, Mich. Water-leaf. Rare. Woods. July.

**PHACELIA** *Purshii*, Buck. Phacelia. Moist river banks.

### BORRAGINACEÆ.

**CYNOGLOSSUM** *officinale*, L. Hound's-tongue. Common. Fields.

*Virginicum*, L. Wild Comfrey. Rare. Dry soils.

**ECHINOSPERMUM** *Virginicum*, Lehm. (*Cynoglossum Morisoni*, DC.) Dry soils.

*Lappula*, Lehm. Stickseed. Common. Dry soils. June.

**MERTENSIA** *Virginica*, DC. Lungwort. Rare. River bottoms. Wayne county.

**LITHOSPERMUM** *arvense*, L. Corn Gromwell. Common. Dry soils. July.

*officinale*, L. Common Gromwell. Common. Dry soils. July.

*latifolium*, Mich. Puccoon. Common. Dry soils. July.

*canescens*, Lehm. Hairy Puccoon. Common. Dry soils. July.

**ONOSMODIUM** *Virginianum*, DC. False Gromwell. Dry soils. July.

*Carolinianum*, DC. False Gromwell. Dry soils. July.

**SYMPHYTUM** *officinale*, L. Corn Comfrey. Rare. Dry soils. July.

## CONVOLVULACEÆ.

- IPOMÆA purpurea*, Lam. Morning Glory. Common. July.  
*pandurata*, Meyer. Wild Potato-vine. Man-of-the-Earth. Found everywhere about dwellings.
- CONVOLVULUS spithamæus*, Pursh. Bracted Bindweed. Dry soils. July.  
*sepium*, L. Hedge Bindweed. Dry soils. July.  
*arvensis*, L. Bindweed.
- CUSCUTA Gronorii*, Willd. Dodder. Parasite on other plants.  
*glomerata*, Choisy. Dodder. Parasite on other plants.

## SOLANACEÆ.

- SOLANUM nigrum*, L. Common Nightshade. Common. Berries black.  
*dulcamara*, L. Bittersweet. Rare. Moist grounds.  
 May by known by its red berries.
- PHYSALIS pubescens*, L. Ground Cherry. Common. Dry grounds.  
*viscosa*, L. Ground Cherry. Common. Dry grounds.  
*lanceolata*, Mich. (*P. Pennsylvanica*, L.) Ground Cherry. Common. Dry grounds.
- NICANDRA physaloides*, Gærtn. Apple of Peru. Rare. Waste grounds.
- LYCIUM vulgare*, Dunal. Matrimony Vine. About dwellings. June.
- DATURA Stramonium*, L. Common "Jimson-weed." Rare.  
*Tatula*, L. Purple "Jimson." Common. Dry soils.

## SCROPHULARIACEÆ.

- VERBASCUM Thapsus*, L. Common Mullein. Common everywhere.  
*Blattaria*, L. Moth Mullein. Common. Dry soils.
- LINARIA vulgaris*, Mill. Butter and Eggs. Toad-flax. Common.

- COLLINSIA *verna*, Nutt. Collinsia. Common. Rich woods.  
May.
- SCROPHULARIA *nodosa*, L. Figwort. Common. Rich soils.  
July.
- CHELONE *glabra*, L. Snake-head. Common. Rich soils. August.
- PENSTEMON *pubescens*, Sol. Beard's-tongue. Common. Moist  
places. July.  
*laevigatus*, Sol., var. *digitalis*, Gray. Beard's-tongue.  
Common. Moist places. July.
- MIMULUS *ringens*, L. Monkey-flower. Common. Wet places.  
July.  
*alatus*, Sol. Monkey-flower. Common. Wet places.  
July.
- GRATIOLA *Virginiana*, L. Hedge Hyssop. Rare.
- ILYSANTHES *gratioloides*, Benth. False Pimpernel. Wet  
grounds.
- VERONICA *Virginica*, L. Culver's root. Common. August.  
*Anagallis*, L. Water Speedwell. Common. Marshes.  
July.  
*officinalis*, L. Common Speedwell. Common. Dry  
hills. July.  
*serpyllifolia*, L. Thyme-leaved Speedwell. Common  
everywhere. May.  
*peregrina*, L. Purslane-Speedwell. Common. Waste  
grounds. May, June.  
*arvensis*, L. Corn-Speedwell. Common. Marshes.  
July.
- GERARDIA *flava*, L. Downy Yellow Foxglove. Dry soils. July.  
*purpurea*, L. Purple Gerardia. Common. Dry soils.  
*tenuifolia*, Vahl. Slender Gerardia. Common. Moist  
soils.
- PEDICULARIS *Canadensis*, L. Lousewort. Rare. Sandy hillsides.  
May.  
*lanceolata*, Mich. Rare. Swamps. Jay county. Sep-  
tember.



## OROBANCHACEÆ.

EPIPHEGUS *Virginiana*, Bart. Beech-drops. Wayne county.  
Parasite on roots of beech trees.

## BIGNONIACEÆ.

TROCOMA *radicans*, Juss. Trumpet Creeper. Common. Moist  
places. July.

CATALPA *speciosa*, Warder. Door yards. Shade tree.

## ACANTHACEÆ.

RUELLIA *strepens*, L. Rich soils.

DIANTHERA *Americana*, L. Water Willow. Common. Borders  
of streams.

## VERBENACEÆ.

PHYRMA *Leptostachya*, L. Lopseed. Common. Woods. July,  
August.

VERBENA *urticifolia*, L. White Vervain. Common. Fields.

*hastata*, L. Blue Vervain. Common everywhere. Au-  
gust.

LIPPIA *lanceolata*, Mich. Frog-fruit. Common. Wet places.  
August.

## LABIATÆ.

TRUCRIUM *Canadense*, L. American Germander. Moist grounds.

COLLINSONIA *canadensis*, L. Stone-root. Common. Rich woods.  
July.

MENTHA *viridis*, L. Spearmint. Common. Damp soils.

*piperita*, L. Peppermint. Common. Damp soils.

*arvensis*, L. Corn-mint. Common. Damp soils.

*Canadensis*, L. Wild-mint. Common. Damp soils.

LYCOPUS *sinuata*, Ell. (*L. Europæus*, var. *sinuata*, Gray) Water  
Hoar-hound. Common. Wet soils. August.

- RYCNANTHEMUM lanceolatum**, Pursh. Mountain-mint. Common.  
Prairies. August.
- CALAMINTHA glabella**, Benth. Common in limestone regions.  
*Nuttallii*, Benth. Common in limestone regions.
- MELISSA officinalis**, L. Common Balm. Rare. July.
- HEDEOMA pulegioides**, Pers. Pennyroyal. Common everywhere.
- MONARDA didyma**, L. Oswego Tea. Rare. Moist places.  
July.  
*fistulosa*, L. Wild Bergamot. Common. Moist places.  
July.  
*Bradburiana*, Beck. Rare. Moist grounds.
- BLEPHILIA ciliata**, Raf. Common. Rich woods.  
*hirsuta*, Benth. Common. Rich woods.
- LOPHANTHUS nepetoides**, Benth. Giant Hyssop. Common.  
Dry woods.  
*scrophulariaefolius*, Benth. Giant Hyssop. Common.  
Dry woods.  
*anisatus*, Benth. Anise Hyssop. Jay county.
- NEPETA Cataria**, L. Catnip. Common around dwellings.  
*Glechoma*, Benth. Ground Ivy. Gill-over-the-ground.  
Common.
- SCUTELLARIA lateriflora**, L. Mad-dog Skullcap. Common.  
Rich woods. July, August.  
*versicolor*, Nutt. Skullcap. Common. Rich woods.  
July, August.  
*canescens*, Nutt. Skullcap. Common. Rich woods.  
July, August.  
*nervosa*, Pursh. Skullcap. Common. Rich woods.  
July, August.
- BRUNELLA vulgaris**, L. Self-heal. Common. Moist grounds.  
June.
- PHYSOSTEGIA Virginiana**, Benth. False Dragon Head. Not  
common. Prairies.
- SYNANDRA grandiflora**, Nutt. Wayne county.
- MARRUBIUM vulgare**, L. Horehound. Not common. Escaped.

LEONURUS *Cardiaca*, L. Common Mother-wort. Common everywhere.

STACHYS *palustris*, L. Hedge-nettle.

*aspera*, Mich. (*S. palustris*, var. *aspera*, Gr.) Hedge-nettle. Common. Banks of streams. July.

*aspera*, var. *glabra*, (*S. palustris*, var. *glabra*, Gr.) Smooth Hedge-nettle. Common. Banks of streams. July.

*cordata*, Riddell. (*S. palustris*, var. *cordata*, Gr.)

### PLANTAGINACEÆ.

PLANTAGO *major*, L. Common Plantain. Common. Door yards.

*lanceolata*, L. English Plantain. Common. Dry sandy grounds.

### ARISTOLOCHIACEÆ.

ASARUM *Canadense*, L. Wild Ginger. Rare. Damp, cool ravines.

ARISTOLOCHIA *Serpentaria*, L. Virginia Snake-root. Rare. Dry soils.

### PHYTOLACCACEÆ.

PHYTOLACCA *decandra*, L. Poke. Garget. Common.

### CHENOPODIACEÆ.

CHENOPODIUM *album*, L. Lamb's-quarters. Pig-weed. Around dwellings.

*viride*, L. Lamb's-quarters. Pig-weed. Around dwellings.

*hybridum*, L. Maple-leaved Goosefoot. Around dwellings.

### AMARANTACEÆ.

AMARANTUS *hypochondriacus*, L. Rare. Probably escaped.

*paniculatus*, L. Prince's Feather-of-the-Garden. Rare.

*retroflexus*, L. Amaranth. Common around dwellings.

*albus*, L. Amaranth. Common around dwellings.

## POLYGONACEÆ.

- Polygonum orientale*, L. Prince's Feather. Escaped.  
*incarnatum*, Ell. Water-pepper. Common. Along streams and ponds.  
*Persicaria*, L. Lady's Thumb. Common. Moist ground. August.  
*Hydropiper*, L. Smart Weed. Common. Moist grounds. August.  
*acre*, HBK. Water Smart Weed. Common. Swamps. August.  
*hydropiperoides*, Mich. Wild Water-pepper. Common. Wet soils.  
*amphibium*, L. Smart Weed. Common. Swamps. August.  
*aviculare* L. Knot-grass. Door-weed. Common. Around dwellings and walks.  
*erectum*, L. (*P. aviculare*, var. *erectum*, Roth.) Larger than the last. Not so common.  
*sagittatum*, L. Tear Thumb. Rare. Very rough.  
*Convolvulus*, L. ? Black Bindweed.  
*dumetorum*, L. Climbing False Buckwheat. Common.
- RUMEX altissimus*, Wood. ? Peach-leaved Dock. Rare.  
*verticillatus*, L. Swamp Dock. Common. Swamps.  
*crispus*, L. Curled dock. Common everywhere.  
*obtusifolius*, L. Bitter Dock. Common everywhere.

## LAURACEÆ.

- SASSAFRAS officinale*, Nees. Sassafras. Common. Woods.  
*LINDERA Benzoin*, Meisner. Spice bush. Common. Woods.

## THYMELEACEÆ.

- DIRCA palustris*, L. Moose-wood. Rare. Jay county.

## SANTALACEÆ.

- COMANDRA umbellata*, Nutt. Bastard Frog-flax. Rare.

## SAURURACEÆ.

- SAURURUS cernuus*, L. Lizard's-tail. Common. Borders of streams and ponds. July.

## EUPHORBIACEÆ.

- EUPHORBIA *maculata*, L. Spurge. Common. Dry soils.  
*hypericifolia*, L. Spurge. Common. Dry soils.  
*corollata*, L. Spurge. Common. Dry soils.  
*commutata*, Engelm. Spurge. Common Dry soils.
- ACALYPHA *Virginica*, L. Three-seeded Mercury. Common. Rich soils.  
*Virginica*, var. *gracilens*, Gray. Three-seeded Mercury. Common. Rich soils.

## URTICACEÆ.

- ULMUS *fulva*, Mich. Slippery Elm. Rare. Woods.  
*Americana*, L. Water Elm. Common. Woods.
- CELTIS *occidentalis*, L. Hackberry. Rare. River bottoms.
- MORUS *rubra*, L. Mulberry. Rare.  
*alba*, L. White Mulberry. Rare.
- URTICA *gracilis*, Ait. Tall Nettle. Common. Fence rows.  
*dioica*, L. Bristly Nettle.
- PILEA *pumila*, Gray. Rich weed. Common. Moist woods. July.
- CANNABIS *sativa*, L. Hemp. Escaped from cultivation.
- HUMULUS *Lupulus*, L. Wild Hop. Rare. July.

## PLATANACEÆ.

- PLATANUS *occidentalis*, L. Sycamore. River bottoms.

## JUGLANDACEÆ.

- JUGLANS *cinerea*, L. Bitternut. Not as common as next, but where large is a valuable tree.  
*nigra*, L. Black Walnut. Common. Valuable tree.
- CARYA *olivæformis*, Nutt. Pecan-nut. River bottoms.  
*alba*, Nutt. Shag-bark Hickory. Common. Woods.  
*microcarpa*, Nutt. Small-fruited Hickory. Common.  
*sulcata*, Nutt. Western Shell-bark Hickory. Common.  
*porcina*, Nutt. Pig-nut. Common. Woods.  
*amara*, Nutt. Bitter-nut. Swamp Hickory.

## CUPULIFERÆ.

- QUERCUS alba*, L. White Oak. Common. Woods. Valuable.  
*macrocarpa*, Mich. Bur Oak. Tree, middle size.  
*rubra*, L. Red Oak. Rare.  
*coccinea*, Wang., var. *tinctoria*, Gr. Black Oak. Rare.  
*palustris*, Du Roi. Spanish or Pin Oak. Common.  
*nigra*, L. Black Jack. Small tree.  
*imbricaria*, Mich. Shingle Oak. Common. Woods.
- CASTANEA vesca*, L., var. *Americana*, Mich. Chestnut. Rare.  
 Probably not native.
- FAGUS ferruginea*, Ait. Beech. Common. Valuable tree.
- CORYLUS Americana*, Walt. Hazel-nut. Very abundant, and  
 forms thickets in places.
- OSTRYA Virginica*, Willd. Iron-wood. Hop-Hornbeam. Com-  
 mon.
- CARPINUS Americana*, Mich. Blue or Water Beech.

## SALICACEÆ.

- SALIX humilis*, Marshall. Prairie Willow. Rare. Dry soils.  
*discolor*, Muhl. Glaucous Willow. Common. Bor-  
 ders of ponds.  
*petiolaris*, Smith. Petioled Willow. Common. Swamps.  
*lucida*, Muhl. Shining Willow. Rare.  
*nigra*, Marsh. Black Willow. Common along streams.  
*alba*, L., var. *vitellina*, Gr. Yellow Willow. Rare.
- POPULUS tremuloides*, Mich. Quaking Asp. Common.  
*heterophylla*, L. Cotton-wood. Rare. Jay county.  
*monilifera*, Ait. Cotton-wood. Common. Large tree.

## ARACEÆ.

- ARISÆMA triphyllum*, Torr. Indian turnip. Rich woods. May-  
*Dracontium*, Schott. Green Dragon. Rich woods.  
 June.
- SYMPLOCARPUS fœtidus*, Salisb. Skunk-cabbage. Bogs. May,  
 June.

*ACORUS Calamus*, L. Sweet Flag. Rare. Swamps and wet places.

### TYPHACEÆ.

*TYPHA latifolia*, L. Cat-tail Flag. Common. Swamps.

*SPARGANIUM eurycarpum*, Engelm. Bur-reed. Along streams and ponds.

*simplex*, Hudson. Bur-reed. Along streams and ponds.

### ALISMACEÆ.

*ALISMA Plantago*, L., var. *Americanum*, Gr. Water Plantain. Common. Shallow water.

*SAGITTARIA variabilis*, Engelm. Arrow-head. Common. Ponds and ditches.

*variabilis*, var. *angustifolia*, Gr. Arrow-head. Common. Ponds and ditches.

### HYDROCHARIDACEÆ.

*ANACHARIS Canadensis*, Planchon. Water-weed. Rare. Leaves minutely serrulate. Still water.

### ORCHIDACEÆ.

*ORCHIS spectabilis*, L. Showy Orchis. Rare. Moist woods. May.

*HRABENARIA psycodes*, Gray. Purple-fringed Orchis. Rare. Jay county.

### AMARYLLIDACEÆ.

*HYPOXIS erecta*, L. Star-grass. Common. Wet meadows.

### IRIDACEÆ.

*IRIS versicolor*, L. Large Blue Flax. Common. Wet places.

*SISYRINCHIUM Bermudiana*, L. Blue-eyed Grass. Common. Moist places.

## DIOSCOREACEÆ.

*DIOSCOREA villosa*, L. Wild Yam. Common. Twining over bushes. July.

## SMILACEÆ.

*SMILAX rotundifolia*, L. Common Green Brier. Common. Along fences.

*hispida*, Muhl. Hispid Green Brier. Common. Moist woods.

*herbacea*, L. Carrion-flower. Common. Along fences.

## LILIACEÆ.

*TRILLIUM sessile*, L. Wakerobin. Common. Moist woods. May.

*recurvatum*, Beck. Not so common as last. May.

*erectum*, L. Wakerobin. Rare.

*cernuum*, L. Nodding Trillium. Rare.

*MEDEOLA Virginiana*, L. Indian Cucumber-root. Common. Moist woods.

*MELANTHIUM Virginicum*, L. Bunch-flower. Wet meadows.

*UVULARIA perfoliata*, L. Bellwort. Common. Rich woods. May.

*grandiflora*, Smith. Rich woods. June.

*SMILACINA racemosa*, Desf. False Solomon's Seal. Woods. May.

*POLYGONATUM biflorum*, Ell. Smaller Solomon's Seal. Woods. May.

*giganteum*, Dietrich. Great Solomon's Seal. Common. June.

*ASPARAGUS officinale*, L. Extensively cultivated.

*LILIUM Canadense*, L. Wild Yellow Lily. Common. Moist woods.

*superbum*, L. Turk's Cap Lily. Randolph.

*ERYTHRONIUM Americanum*, Smith. Yellow Dog-toothed Violet. Common. April, May.

*album*, Nutt. White Dog-toothed Violet. Rare.



- ORNITHOGALUM** *umbellatum*, L. Star-of-Bethlehem. Escaped.  
**CAMASSIA** *Fraseri*, Torr. (*Scilla Fraseri*, Gr.) Wild Hyacinth.  
 Common. Rich woods.  
**ALLIUM** *triccocum*, Ait. Wild Leek. Common. June.  
*cernuum*, Roth. Wild Onion. Common. June.  
*Canadense*, Kalm. Wild Garlic. Common. June.

### JUNCACEÆ.

- LUZULA** *campestris*, DC. Wood Rush. Common. Dry soils.  
 May.  
**JUNCUS** *effusus*, L. Soft Rush. Bullrush. June.  
*tenuis*, Willd. Rush. Common. Moist places. June.  
*dichotomus*, Ell. Rush. Randolph county. July.  
*acuminatus*, Mich. var. *legitimus* (*J. Pondii*). Rare.  
 July.

### COMMELINACEÆ.

- TRADESCANTIA** *Virginica*, L. Common Spiderwort. Common.  
 Dry soils. May.  
*pilosa*, Lehm. Tall Spiderwort. Common. June.

### CYPERACEÆ.

- CYPERUS** *diandrus*, Torr. Common. Moist grounds. August.  
*strigosus*, L. Common. Moist grounds. August.  
**ELEOCHARIS** *obtusa*, Schultes. Spike Rush. Common. June.  
*olivacea*, Torr. Spike Rush. Common. Wet grounds.  
*palustris*, R. Br. Spike Rush. Common. June.  
*tenuis*, Schultes. Spike Rush. Common. June.  
*acicularis*, R. Br. Spike Rush. Rare. Swamps.  
 August.  
**SCRIPUS** *pungens*, Vahl. Common. River borders. July.  
*validus*, Vahl. Great Bullrush. Very common. June.  
*fluviatilis*, Gray. Club-rush. Rare. Swamps. May.  
*atrovirens*, Muhl. Common. Swamps. June.  
*lineatus*, Mich. Common. Low grounds. June.  
*Eriophorum*, Mich. Common. Wet meadows. August.

- CAREX** *Stuedelii*, Kunth. Sedge. Rare. May.  
*vulpinoidea*, Mich. Sedge. Common. June.  
*Nuttallii*, Schw. Sedge. Rare. May.  
*stipata*, Muhl. Sedge. Common. June.  
*conjuncta*, Boot. Sedge. Common. June.  
*alopecoidea*, Tuck. Sedge. Common. June.  
*cephalophora*, Muhl. Sedge. Rare. May.  
*rosea*, Schk. Sedge. Common. May.  
*lagopodioides*, Schk. Sedge. Rare. July.  
*stellulata*, L. Sedge. Rare. June.  
*straminea*, Schk. Sedge. Common. June.  
*crinita*, Lam. Sedge. Rare. May.  
*Shortiana*, Dew. Sedge. Common. June.  
*grisea*, Wahl. Sedge. Common. May.  
*Davisii*, Torr. Sedge. Very rare. June.  
*gracillima*, Schw. Sedge. Common. May.  
*digitalis*, Willd. Sedge. Rare. May.  
*ulxiflora*, Lam. Sedge. Common. May to July-  
 var. *styloflexa*, Boot. Sedge. May.  
 var. *blanda*, Carey. Sedge. May.  
 var. *latifolia*, Boot. Sedge. May.  
*oligocarpa*, Schk. Sedge. Common. May.  
*Pennsylvanica*, Lam. Sedge. Common. May.  
*riparia*, Curtis. Sedge. Rare. May, June.  
*pubescens*, Muhl. Sedge. Common. June.  
*hystericina*, Willd. Sedge. Rare. June.  
*tentaculata*, Muhl. Sedge. Rare. June.  
*Grayii*, Carey. Sedge. Rare. June.  
*lupulina*, Muhl. Sedge. Common. June.  
*lupuliformis*, Sart. Sedge. Rare. July.  
*squarrosa*, L. Sedge. Common. June.  
*utriculata*, Boot. Sedge. Rare.  
*Tuckermani*; Boot. Sedge. Common. May.  
*stenolopis*, Torr. Sedge. Common. June.

## GRAMINEÆ.

- LEERSIA** *Virginica*, Willd. White Grass. Common. Swamps.  
 September.  
*oryzoides*, Swartz. Rice Cut Grass. Common. Sep-  
 tember.

- ZIZANIA aquatica*, L. Indian Rice. Shallow water.
- PHLEUM pratense*, L. Timothy. Common everywhere.
- VILFA vaginæflora*, Torr. Rare. Dry grounds. September.
- AGROSTIS perennans*, Tuck. Thin grass. Shaded grounds.  
*scabra*, Willd. Hair grass. Rare. Wet places. July.  
*vulgaris*, With. Red-top. Common. Wet soils.  
*alba*, L. White Bent grass. Rare. July.
- CINNA arundinacea*, L. Wood Reed grass. Shaded swamps.  
 August.
- MUHLENBERGIA diffusa*, Schreber. Drop-seed grass. Common.
- CALAMAGROSTIS Canadensis*, Beauv. Blue Joint grass. Wet  
 soils. July.
- DACTYLOCTENIUM Ægyptiacum*, Willd. Egyptian grass. Common.
- ELEUSINE Indica*, Gærtn. Wire grass. Common. Yards.
- DACTYLIS glomerata*, L. Orchard grass. Common. Valuable.
- EATONIA Pennsylvanica*, Gray. Common. June.
- GLYCERIA elongata*, Trin. Manna grass. Rare. Wet meadows.  
*nervata*, Trin. Fowl-meadow grass. Common. Wet  
 woods.  
*pallida*, Trin. Fowl-meadow grass. Common.  
*fluitans*, R. Br. Rare. Swamps.
- POA annua*, L. Low Spear-grass.  
*compressa*, L. Wire grass. Common. July.  
*pratensis*, L. Blue grass. Common. June.  
*alsodes*, Gray. Rare. Woods and hillsides.
- ERAGROSTIS pilosa*, Beauv. Rare. Dry soils. August.  
*Frankii*, Meyer. Border of streams. Sandy soils. Sep-  
 tember.  
*capillaris*, Nees. Rare. Sandy soils. August.  
*pectinacea*, Gray. Common. August.  
*pectinacea. var. spectabilis*. Common. August.
- FESTUCA elatior*, Gibson. Common. Wet meadows. June.  
*elatior, var. pratensis*, Huds. Common. Moist soils. June.  
*nutans*, Wild. Common. Moist soils. June.

- BROMUS** *secalinus*, L. Cheat or Chess. Nuisance in wheat fields.  
*racemosus*, L. Upright Chess. Common. Fields.  
*ciliatus*, L. Common. Moist woods.
- PHRAGMITES** *communis*, Trin. Reed grass. Common. Swamps.  
 August. Very tall. Some specimens 12 to 15 feet. Largest species of the order.
- TRITICUM** *repens*, L. Quick grass. Randolph county.
- ELYMUS** *Virginicus*, L. Wild Rye. Common. River banks.  
 July.  
*Canadensis*, L. Wild Rye. Common. River banks.  
 July.  
*striatus*, Willd. Wild Rye. Common. River banks.  
 July.
- GYMNOSTICHUM** *Hystrix*, Schreb. Bottle-brush grass. Moist woods. July.
- DANTHONIA** *spicata*, Beauv. Wild-oat grass. Rare. June.
- PHALARIS** *Canariensis*, L. Canary grass. Escaped.
- PANICUM** *capillare*, L. Old Witch grass. Dry soils.  
*latifolium*, L. Panic grass. Common. Dry soils.  
*Crus-galli*, L. Barnyard grass. Common. Fields.
- SETARIA** *glauca*, Beauv. Fox tail grass. Common. Cultivated fields.  
*viridis*, Beauv. Bottle grass. Common. Cultivated fields.  
*Italica*, Kunth. Millett. Rare. Rich soils.
- ANDROPOGON** *furcatus*, Muhl. Beard grass. Common. Sandy soils. August.
- SORGHUM** *nutans*, Gray. Indian Grass. Rare. Rich fields. September.

## EQUISETACEÆ.

- EQUISETUM** *arvense*, L. Common Horse-tail. Moist, gravelly soils.  
*hyemale*, L. Scouring Rush. Cold, wet banks.

## FILICES.

- POLYPODIUM** *vulgare*, L. Polypod Fern. Common. Moist woods.
- PTERIS** *aquilina*, L. Common Brake Fern. Wayne county.
- ADIANTUM** *pedatum*, L. Maiden-hair Fern. Common. August.
- ASPLENIUM** *angustifolium*, Mich. Spleenwort. Moist woods.  
*thelypteroides*, Mich. Common. Rich woods and swamps. Wayne county.  
*Filix-fœmina*, Bernh. Common. Moist woods. July.  
*Filix-fœmina*, var. *Michauxii*. Moist woods.
- CAMPTOSORUS** *rhizophyllus*, Link. Walking Leaf. Wayne county.
- PHEGOPTERIS** *hexagonoptera*, Fee. Beech Fern. Wayne county.
- ASPIDIUM** *Noveboracense*, Swartz. Wood Fern. Wayne county.  
*thelypteris*, Swartz. Wood Fern. Swamps.  
*Goldianum*, Hood. Wayne county.  
*spinulosum*, Swartz. var. *intermedium*, Willd. Moist woods.  
*acrostichoides*, Swartz. Wood Fern. Wayne county.  
*acrostichoides*, var. *incisum*. Wood Fern. Wayne county.
- CYSTOPTERIS** *fragilis* Bernh. Bladder Fern. Wayne county.  
*bulbifera*, Bernh. Bladder Fern. Wayne county.
- ONOCLEA** *sensibilis*, L. Sensitive Fern. Common. Wet grounds.
- OSMUNDA** *regalis*, L. Flower Fern. Jay county.  
*Claytoniana*, L. Randolph county. June.  
*cinnamomea*, L. Cinnamon Fern. Wayne county.

These three species are among the largest of the ferns; the second, in Ohio, frequently attaining a height of six or eight feet. It there grows in tufts in swamps.

## OPHIOGLOSSACEÆ.

- BOTRYCHIUM** *ternatum*, Swartz. Moonwort-Fern. Wayne county.  
*Virginianus*, Swartz. Moonwort-Fern. Common. Moist woods.

Orders, 91; genera, 370; species, 789.

Delaware county, 720; Wayne, 43; Randolph, 11; Jay, 15.

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PALEONTOLOGY.

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# PALEONTOLOGY.

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## VAN CLEVE'S FOSSIL CORALS.

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IDENTIFIED AND COMPILED

By PROFESSOR JAMES HALL.

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This work is a continuation of that by Dr. C. A. White, in the previous report for 1881, and is published with the desire of preserving some of Mr. Van Cleve's work on the fossil corals. The engraved plates and manuscripts of Mr. Van Cleve have been compared with the published descriptions of American corals, and the species identified so far as possible. The descriptions of the species have been compiled largely from their original sources. These, with the accompanying illustrations, will enable the student to identify many of the common and characteristic forms of the fossil corals of Indiana.

A list of the species published in the previous report is herewith given; and, also, those of the present paper, with references to the MSS. names of Mr. Van Cleve.

The labor of comparison and arrangement of the material has been principally done by Mr. C. E. Beecher, under my dictation and supervision.

List of species published in the Indiana Geological Report for 1881:

### LOWER SILURIAN.

- Streptelasma corniculum*, Hall.
- Palæophyllum divaricans*, Nicholson.
- Favistella stellata*, Hall.
- Protarea vetusta*, Edwards & Haine.
- Constellaria antheloidea*, Hall.
- Monticulipora frondosa*, D'Orbigny.



## UPPER SILURIAN.

*Lyellia americana*, Edwards & Haime.

*Halysites catenulata*, Linnæus.

*Heliolites elegans*, Hall.

*Favosites favosus*, Goldfuss.

*Cladopora reticulata*, Hall.

*Clathropora frondosa*, Hall.

## DEVONIAN.

*Acerularia davidsoni*, Edwards & Haime.

*Diphyphyllum archiaci*, Billings.

“ *stramineum*, Billings.

“ *arundinaceum*, Billings.

*Eridophyllum strictum*, Edwards & Haime.

*Cystiphyllum vesiculosum*, Goldfuss.

*Zaphrentis rafinesquii*, Edwards & Haime.

*Aplexus yandelli*, Edwards & Haime.

*Favosites basaltica*, Goldfuss.

“ *polymorpha*, Goldfuss.

“ “ *var. dubia*, Goldfuss.

*Fistulipora canadensis*, Billings.

*Alveolites goldfussi*, Billings.

*Striatopora linnæana*, Billings.

*Syringopora perelegans*, Billings.

“ *maclurei*, Billings.

*Stromatopora pustulifera*? Winchell.

## LOWER CARBONIFEROUS.

*Lithostrotion mammillare*, Castelnau.

In the present paper the following species are described, or referred to:

## TRENTON LIMESTONE.

*Receptaculites oweni* Hall = *Coscinopora sulcata*, (Goldfuss), Van Cleve.

## CORALS.

## HUDSON RIVER GROUP.

- Favistella stellata*, Hall=*Astrea prismatica*, Van Cleave.
- Monticulipora discoidea* James=*Ceriopora orbiculata*, Van Cleave.
- “ *gracilis*, James=*Ceriopora tenuis*, Van Cleave.
- “ *jamesi* Nicholson=in part, *Ceriopora multiformis*, Van Cleave.
- “ *andrewsi* Nicholson=in part, *Ceriopora multiformis*, Van Cleave.
- “ *ulrichi* Nicholson=in part, *Ceriopora multiformis*, Van Cleave.
- “ *dalii* Edwards & Haime=in part, *Ceriopora muricata*, Van Cleave.
- “ *mammulata* D’Orbigny.=in part, *Ceriopora muricata*, Van Cleave.
- “ *approximata*=Nicholson *Ceriopora mammulata*, Van Cleave.
- “ *tuberculata*=Edwards & Haime=*Ceriopora tuberculata*, Van Cleave.
- Palæophyllum divaricans* Nicholson=*Cyathophyllum dianthus*, (Goldfuss), Van Cleave.

## NIAGARA GROUP.

- Heliolites interstinctus*, Linne=*Astrea porosa*, (Goldfuss), Van Cleave.
- Lyellia americana* Edwards & Haime=*Astrea vesiculosa*, Van Cleave.
- Favosites favosus* Goldfuss=*Calamopora favosa*, (Goldfuss), Van Cleave.
- Thecia major*, Rominger=*Astrea septa*, Van Cleave.
- Syringopora verticillata* Goldfuss=*Syringopora verticillata*, (Goldfuss), Van Cleave.
- Aulopora vanclevii* Hall=*Aulopora serpens*, (Goldfuss), Van Cleave.
- Eridophyllum rugosum* Edwards & Haime.=*Lithodendron larviformis*, Van Cleave.

## CORNIFEROUS LIMESTONE.

- Favosites emmonsii*, Rominger=*Calamopora* —, Van Cleve.  
 “ *limitaris*, “ “ *spongites* (Goldf.), “  
 “ *hemisphericus* Yandell & Shumard=*alveolaris*, (Goldfuss), Van Cleve.  
*Syringopora perelegans* Billings=*Syringopora caespitosa*, (Goldfuss), Van Cleve.  
*Heliophyllum halli* Edwards & Haime=*Cyathophyllum turbintum*, (Goldfuss), Van Cleve.  
*Heliophyllum coalitum*, Rominger. = *Cyathophyllum helianthoides*, (Goldfuss), Van Cleve.  
*Cyathophyllum rugosum*, Edwards & Haime. = *Cyathophyllum hexagonum*, (Goldfuss), Van Cleve.  
*Diphyphyllum stramineum*, Billings. = *Lithodendron flexuosum*, Van Cleve.  
*Eridophyllum verneuilianum*, Edwards & Haime. = *Lithodendron verticillatum*, Van Cleve.  
*Eridophyllum simcoense*, Billings. = *Lithodendron remiculare*, Van Cleve.  
*Cystiphyllum pustulatum*, Hall. = *Cyathophyllum vesiculosum*, (Goldfuss), Van Cleve.  
*Syringostroma densum*, Nicholson. = *Agaricia boletiformis*, (Goldfuss), Van Cleve.

## BRYOZOA.

## HUDSON RIVER GROUP.

- Ptilodictya falciformis*, Nicholson. = *Cerriopora ensiformis*, Van Cleve.

## CLINTON GROUP.

- Ptilodictya expansa*, Hall & Whitfield. = *Ptilodictya lanceolata*, (Goldfuss), Van Cleve.  
*Ptilodictya bipunctata*, Van Cleve. = *Ptilodictya bipunctata*, Van Cleve.

*Stictopora compressa*, Van Cleve. = *Eschara compressa*, Van Cleve.

*Stictopora bifurcata*, Van Cleve. = *Eschara bifurcata*, Van Cleve.

*Stictopora Van clevii*, Hall. = *Eschara ramosa*, Van Cleve.

*Stictopora multifida*, Van Cleve. = *Eschara multifida*, Van Cleve.

*Retepora angulata*, Hall. = *Retepora producta*, Van Cleve.

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## TRENTON LIMESTONE.

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### PROTISTA.

#### RECEPTACULITES, *De France*.

##### RECEPTACULITES OWENI.

###### *Plate 1, Fig. 1.*

*Receptaculites Oweni*, HALL. Geological Report, Wisconsin, 1861.

*Coscinopora sulcata* (Goldfuss), VAN CLEVE MSS., 1853.

Specimens of this species were obtained from the lead-bearing rocks of Iowa, and identified with *Coscinopora sulcata*, of Goldfuss, by Mr. Van Cleve. Dr. Owen had previously made the same identification, and termed the lead-bearing rock as the "Coscinopora beds." (Report on the Mineral Region of the Northwest, p. 40, 1844.)

*Original Description*.—Body consisting of a broad, expanded disc, from four to twelve inches in width, and from one-quarter to half an inch in thickness (rarely a little thicker); surface undulating, with an abrupt funnel-shaped depression in the center of the upper side, from which the cell-rows radiate in curved lines.

The thickness in the center is not more than one-eighth of an inch, and at a distance of three or four inches from the center is less than half an inch; cells cylindrical in the middle and contracted above and below, the walls of the cavities often showing transverse striæ, which appear like the remains of

septa. The distance of the cells from each other is variable, those near the center being closer together, though, in receding from the center, there are, at intervals, intercalated rows of cells, which take the same direction, and give the cells a closer arrangement toward the margin than in the intermediate space before the intercalation of the additional rows. The apertures, both above and below, are essentially rhomboidal; but in well preserved surfaces there are remains of rays, which, however, are rarely observed, and I have not seen them on the opposite sides of the same specimen.

The various stages of decomposition, and degrees of preservation, present a great variety of surface aspect. In some conditions there is visible a distinct groove, extending along the surface from one cell to the next, across the curving interspaces.

*Geological Formation and Localities.*—In the Galena limestone of Wisconsin, Northern Illinois, and the eastern part of Iowa, this fossil is everywhere present, and is the most marked and characteristic form in the rock.

Specimens of *Receptaculites* are found in the Niagara group of Indiana. They offer such varied conditions of preservation, and their true nature and structure is so little understood, that extracts from a paper by Mr. Billings upon this subject are here introduced, giving the results of comparisons between a number of species and many individuals. The paper in question appeared in the "Canadian Naturalist" for June, 1865.

"The genus may be described as consisting of organisms, which, when full-grown and perfect, are of a discoid, cylindrical, ovate or globular shape, hollow within, and usually, if not always, with an aperture in the upper side. In or near the center of the lower side there is generally to be seen a small rounded protuberance, indicating, most probably, the position of the primitive cell or nucleus from which the animal commenced its growth. In some species the lower side is more or less concave, and often the nucleus is not at all elevated above the surface adjacent thereto. Its place, however, in the absence of any other guide, may generally be found by observing the point toward which the spiral lines or rows of plates on the outer surface converge. The body-wall is of a somewhat complex structure. It consists of three parts—an external and an internal integument, and, between these, the peculiar tubular or spicular skeleton presently to be described. The external integument may be called the 'ectorhin,' and the internal the 'endorhin.'"

“The ectorhin is usually composed of numerous small rhomboidal plates, closely fitting together, and arranged in curved rows, which radiate in all directions from the nucleus outward to the peripheral margin of the base, and thence, ascending, converge to the edge of the aperture in the upper side. Two or three of these rows of plates (the precise number is not yet determined) originate in the nucleus, and, as they diverge from each other, new rows are introduced between them. The number of rows diminish again on the upper side according as they converge toward the apex of the fossil. The plates at and immediately around the nucleus, and also toward the center of the upper side, are somewhat smaller than they are at the widest part or middle region of the body. It seems probable that, in some of the species, this integument was of a flexible, coriaceous consistence. In others, the plates were solid. In *R. occidentalis* (Salter), when silicified specimens are treated with acid, the plates are easily separable; and, therefore, although in close contact, they are not anchylosed together.

“The endorhin is also composed of small rhomboidal plates, arranged in curving rows, but it differs from the ectorhin in being perforated by numerous small circular orifices, one of which is situated at each point where the angles of four plates meet. From the center of each of the plates of this integument there radiate four small canals, one proceeding straight to the middle of each of the sides of the plate, where it communicates with a similar canal in the adjoining plates. Each of these plates is, therefore, connected by these canals with the four plates in contact with it. The canals are excavated in the substance of the plates, and communicate with the central canal of the transverse tubes. The canals are not always perfectly circular, but are often flattened or irregularly circular. The endorhin varies greatly in the extent to which it is developed. In some specimens the plates are well defined and rhomboidal, with perfectly circular pores at the angles. In others the plates are not at all defined, the ectorhin being one continuous integument without sutures, but always with the full complement of pores. The latter, in such specimens, are not all circular, but are variously shaped orifices, sometimes with rough edges. There are also specimens in which the endorhin consists of only a thin film capping, as it were, the tubes and inclosing the canals, the pores being proportionally larger than they are in those with well-developed plates. The end of each tube in these specimens forms an irregular, rounded tubercle, instead of a rhomboidal plate.”

“The tubular skeleton, above alluded to, consists of numerous small, straight, rarely curved, cylindrical tubes or hollow spicula, placed parallel to each other and at right angles to the

plane of the body-wall, of which they form the greater portion. They connect, and at the same time keep asunder the ectorhin and the endorhin. One of these tubes springs from the center of each plate of the ectorhin. It is, at its base, or next to the ectorhin, very slender, but enlarges so as to attain its full thickness at about one-fourth of its length, and then remains at the same diameter throughout until it reaches the endorhin, by a single plate, of which its inner extremity is, as it were, capped. The outer extremity of each tube has four slender stolons, one proceeding to each of the four angles of that particular plate of the ectorhin from the center of which it (the tube) springs. It there seems to form a connection with the stolons of the three adjacent plates, whose angles meet at that point. The stolons are so arranged that one of them always points inwards towards the nucleus, and another, on the opposite side of the tube, outwards or upwards. It is proposed to call these the radial stolons; they form continuous lines, radiating in all directions away from the nucleus. The other two stolons of each tube project at right angles to the direction of the radial stolons; they form circles around the nucleus, and may, therefore, be called the cyclical stolons. The connection of all these different parts may be better understood by studying the following figures:"

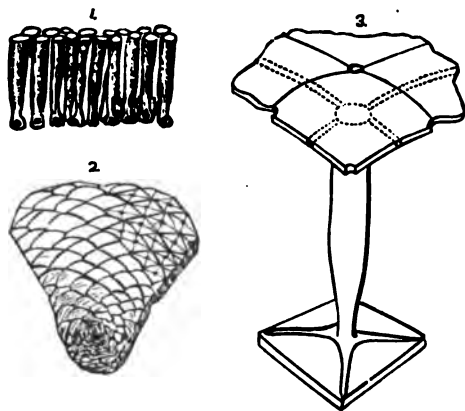


Figure 1, is of a small portion of the body-walls, broken transversely to show the tubes and the apertures of the hollow stolons. Figure 2 represents the usual appearance of the lower portion. One corner of the specimen is represented as denuded of the ectorhin, showing the characters beneath, which are explained by reference to figure 3, which is a diagrammatic restoration, showing the features described above. These figures are somewhat abridged from those given in the "Canadian Naturalist."

## POLYPI.

## HUDSON RIVER GROUP.

## COLUMNARIA, GOLDFUSS.

## FAVISTELLA, HALL.

## FAVISTELLA STELLATA.

Plate 1, Figs. 2, 3, 4.

- Favistella stellata*, HALL. Pal. N. Y. vol. i, 1847.  
 " " " WHITE. Geology and Natural History of Indiana, 11th  
 Report, 1881, p. 378.

The figures of this species on plate 1, are given in addition to those identified by Mr. White, and serve to further illustrate this characteristic species of the Hudson River group.

This species is abundant in the upper part of the Hudson River Group at Madison and other localities in Indiana.

MONTICULIPORA,\* *D'Orbigny*.

## MONTICULIPORA DISCOIDEA.

Plate 10—Figs. 4, 5.

- Chatetes discoideus*, JAMES. Cat. Low. Sil. Foss., 1871.  
 " " " NICHOLSON. Pal. Ohio, vol. ii, p. 206, 1875.  
*Cerriopora orbiculata*, VAN CLEVE MSS., 1853.

"Corallum free, discoid, sharp-edged, concavo-convex, from five to eight lines in diameter, and from one to nearly two lines in greatest thickness. Under surface concave, covered with a very thin epitheca, which but for one or two obscure concentric wrinkles, is nearly smooth, and which is in general so delicate as to reveal clearly through its substance the bases of the superjacent corallites. Upper surface gently convex, not ex-

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\*The following species have been described under the genus *Monticulipora*, and some of them have been more recently arranged by Nicholson under new subgeneric designations. Other subgenera have also been proposed by Mr. Ulrich, and there is still a want of agreement among the several authors who have described the species of this group of fossils. The material at the disposal of the writer for the present purpose does not afford the means for critical discussion, nor is the subject, under any circumstances, an inviting one at the present time.



hibiting any tubercles or elevations of any kind. Corallites sub-equal, the larger ones usually scattered irregularly amongst the smaller ones, and rarely aggregated into distinct groups. Calices with moderately thin walls, polygonal or sub-circular, from eight to ten in the space of one line. The ordinary corallites are not separated by any system of minute intermediate tubuli." (Nicholson Pal. Ohio, vol. ii, p. 206, 1875.) •

*Formation and Localities.*—In the Hudson river group of Indiana and Ohio.

#### MONTICULIPORA GRACILIS.

*Plate 10, Figs. 1, 2, 3, and Plate 11, Fig. 11.*

*Chetetes gracilis*, JAMES. Cat. Foss. Cincinnati Group. 1871.

*Cerriopora tenuis*, VAN CLEVE MSS., 1853.

"Corallum dendroid, the branches solid or hollow, cylindrical or sub-cylindrical, dividing dichotomously at short intervals and at very acute angles (usually from 25° to 40°), from less than one line to two lines or more in diameter. Corallites very small, from ten to twelve in the space of one line, opening obliquely on the surface by oval or sub-triangular calices, the walls of which are separated by very distinct lines of demarkation, and between which are placed more or fewer very minute tubuli. The surface shows no elevations or tubercles, but is entirely smooth, and altogether destitute of any groups of large-sized corallites. The margins of the calices are sometimes finely granulated. This species may, in general, be distinguished by the oval, or rounded, thick-walled calices, and the minute dimensions of the ordinary corallites, together with the marked obliquity of the corallites to the surface, and the very acute angle at which the stems bifurcate." (Nicholson, Pal. Ohio, vol. ii, p. 198, 1875.)

*Formation and Localities.*—Hudson River group, Indiana and Ohio.

#### MONTICULIPORA JAMESI.

*Plate 11, Fig. 8.*

*Chetetes Jamesi*, NICHOLSON. Pal. Ohio, vol. ii, p. 200, 1875.

In part *Cerriopora multiformis*, VAN CLEVE MSS., 1853.

"Corallum of cylindrical or sub-cylindrical, usually hollow branches, the diameter of which is from three to five lines, or of lobate or sub-palmate masses, the extremities of which are rounded. Branches, in the ramose examples, dividing dichotomously at varying intervals, irregularly thickened and nodulated. Corallites oval, circular, or sub-polygonal in section, of

unequal sizes. The larger corallites are about six in the space of one line, with extremely thick walls, the margins of the oval or rounded calices being generally obscurely tuberculated or granulated. The large corallites are occasionally separated by extremely minute cylindrical tubuli, which vary in number in different specimens, or in different parts of the same specimen, their presence, however, usually being a little conspicuous. The surface exhibits no eminences or tubercles of any kind, nor are there any groups of large sized corallites; but typical specimens exhibit, at irregular intervals, stellate spaces, which are either solid or minutely punctate, and which have a diameter of about two-thirds of a line." (Nicholson, Pal. Ohio, vol. ii, p. 200, 1875.)

*Formation and Localities.*—Hudson River group, Ohio and Indiana.

#### MONTICULIPORA ANDREWSI.

*Plate 11, Fig. 9.*

*Monticulipora andrewsi*, NICHOLSON. Structure and affinities of *Monticulipora*, 1881. In part *Ceriopora multiformis*, VAN CLEVE MSS., 1853.

#### MONTICULIPORA ULRICHI.

*Plate 11, Fig. 10.*

*Monticulipora ulrichi*, NICHOLSON. Structure and affinities of *Monticulipora*, 1881. In part *Ceriopora multiformis*, VAN CLEVE MSS., 1853.

#### MONTICULIPORA DALII.

*Plate 11, Fig. 2.*

*Chaetetes dalii*, E. & H. Pal. Foss. des Terr. Pal., 1851.

In part *Ceriopora muricata*, VAN CLEVE MSS., 1853.

*Monticulipora ramosa*, E. & H., as identified by some authors.

"Corallum branching, the stems cylindrical or elliptical, diverging dichotomously at short intervals, sometimes reticulating their average diameter when full grown from three to four lines, but when immature from one to two lines. Calices in general, six to eight in the space of one line, polygonal, with moderately thick walls. A greater or less number of exceedingly small calices always intercalated among the ordinary corallites. Surface covered with conical, often sharply pointed, rarely transversely elongated eminences or tubercles, which sometimes attain a height of more than half a line, and which are placed at distances apart of from half a line to nearly one line. Commonly these eminences are arranged in irregular

diagonal lines, and they are always occupied by corallites which do not exceed the average in point of size. The summits of the tubercles, indeed, are not unfrequently solid, or are occupied by corallites of less than average size." (Nicholson, Pal. Ohio, vol. ii, p. 192, 1875.)

*Formation and Localities.*—Hudson River group, Indiana and Ohio.

#### MONTICULIPORA MAMMULATA.

Plate 11, Fig. 1.

*Monticulipora mammulata*, D'ORBIGNY. Podr. de Paleont., 1850.  
In part *Cerriopora muricata*, VAN CLEVE MSS., 1853.

"Corallum forming irregular expansions of very considerable size, sometimes palmate or lobate, carrying the polypes on both sides; thickness of the corallum usually varying from two to four lines; surface covered with well-marked and prominent tuberosities, usually of a rounded or obtusely conical form, the elevation of which varies in different specimens. The tubercles are somewhat irregularly arranged, at intervals of one line to a line and a half apart, and they are covered with calices which are very slightly larger than the average, occasionally with some very minute tubes interspersed amongst them. The corallites are sub-equal, polygonal, with thin walls, from eight to ten in the space of one line. Very rarely one or two very minute calices may be detected at the angles of the average corallites." (Nicholson, Pal. Ohio, vol. ii, p. 207, 1875.)

*Formation and Localities.*—In the shales of the Hudson River group, Indiana and Ohio.

#### MONTICULIPORA APPROXIMATA.

Plate 11, Fig. 6.

*Chetetes approximatus*, NICHOLSON. Pal. Ohio, vol. ii, p. 193, 1875.  
*Cerriopora mammulata*, VAN CLEVE MSS., 1853.

"Corallum composed of cylindrical stems, from one and a half to nearly three lines in diameter, dividing dichotomously at short intervals. Corallites tolerably thick-walled, oval, sub-circular, or polygonal in shape, from eight to ten in the space of one line, often with excessively minute corallites interspersed amongst them, though these are rarely as abundant as in the preceding forms, and may be nearly absent. Surface exhibiting a number of small conical or somewhat transversely elongated eminences, which are very slightly elevated above the general surface. These eminences are placed in irregular diag-

onal rows, separate about half a line transversely and two-thirds of a line measured vertically, and they are either solid at their summit or carry a few excessively small cylindrical tubuli, with or without one or more of the ordinary corallites." (Nicholson, Pal. Ohio, vol. ii, p. 193, 1875.)

*Formation and Localities.*—Hudson River group, Ohio and Indiana.

For reference to figures 3, 4, 5, 7, 12 and 13, see explanations of plate 11.

### MONTICULIPORA TUBERCLATA.

*Plate 10, Fig. 6.*

*Chaetetes tuberculatus*, E. AND H. Pal. Foss. des Terr. Pal., 1851.

Compare *Chaetetes corticans*, NICHOLSON. Pal. Ohio, vol. ii, p. 210, 1875.

*Cerriopora tuberculata*, VAN CLEVE MSS., 1853.

Mr. Van Cleve had intended giving the same specific name to this fossil as was published by Edwards & Haime. In his MSS. description he says:

"Forms a covering upon other fossils; the specimens thus far found having been in every case upon fragments of orthoceratites. The surface is set with carinate tubercles, alternating with each other in perpendicular ranges, and having their longer diameters in the direction of the ranges. The cell-mouths are equal, and cover alike the tubercles and the spaces between them."

*Formation and Localities.*—Hudson River group, Indiana and Ohio.

### PALÆOPHYLLUM, *Billings.*

#### PALÆOPHYLLUM DIVARICANS.

*Plate 1, Fig. 5.*

*Cyathophyllum dianthus*, (Goldfuss,) VAN CLEVE MSS., 1853.

*Palæophyllum divaricans*, NICHOLSON. Pal. Ohio, vol. ii, 1875.

*Palæophyllum divaricans*, (Nicholson), WHITE. Geology and Natural History, Indiana, 11th Report, p. 377, 1881.

A description of this species is given in the Indiana Report, loc. cit.

## NIAGARA GROUP.

HELIOLITES, *Guettard*.

## HELIOLITES INTERSTINCTUS.

*Plate 2, Figs. 1, 2, 3.*

*Madrepora interstincta*, LINNÉ. Syst. Nat., 1767.

*Astrea vesiculosa*, VAN CLEVE MSS., 1853.

Mr. Van Cleve's description probably refers to this species, although his figures are not perfectly clear. The description, as taken from his manuscript is as follows:

"*Astrea* fungiform, or somewhat branched; stars equal, distant, sunken; lamellæ few; interstices porous."

"This coral is found nodular, semiglobular, fungiform with stipes of various length, and occasionally in fragments exhibiting a branched structure. The entire surface is covered with small pores, like punctures of a needle, among which small, deep stars are sunken. They stand without order, rather distant from each other, and have only 12 or 14 slight lamellæ. The stars and pores are upon both the upper and lower surfaces, and upon the stipes of the fungiform specimens also."

*Formation and Localities.*—"Gravel, Dayton, silicious, Huntington, Indiana.

Specimens of this species are numerous in Indiana, Kentucky and Tennessee, and of less frequent occurrence in Michigan and other localities.

LYELLIA, *Edwards & Haime*.

## LYELLIA AMERICANA.

*Plate 2, Figs. 4, 5; Plate 3, Fig 7.*

*Lyellia Americana*, E. & H. Mon. Pal. Foss. Terr. Pal., 1851.

*Astrea porosa*, (Goldfuss) VAN CLEVE MSS., 1853.

*Lyellia Americana*, (E. & H.) WHITE. Geology and Nat. Hist. Indiana, 11 Report, p. 381, 1881.

The figure given on plate 47 of the 11th Report (plate 3, fig. 7, of this Report) represents a much weathered specimen and special phase of the occurrence of this species. Figures 4 and 5 on plate 2, are enlargements, showing the structure of the corallum.

THECIA, *Edwards & Haime.*

## THECIA MAJOR.

*Plate 2, Fig. 6.**Astreua septa*, VAN CLEVE MSS., 1853.*Thecia major*, ROMINGER. Geol. Surv. Mich. Pal., p. 67, 1876.

The figure referred to this species on plate 2, has somewhat larger corallites than is common; but the description given by Mr. Van Cleve corresponds very closely with the original description of Dr. Rominger, which is as follows:

“Discoid lenticular expansions, covered on the lower side by a concentrically wrinkled epitheca, with diverging striæ, indicating the outlines of procumbent tubes, which bend into an erect position before they open on the upper surface of the disks. Diameter of tubes two millimeters, joining under well-marked, obtusely crested, polygonal margins, which inclose dilated artificial pits. Walls stout, but variable in thickness in different portions of the same specimens. Twelve radial crests extend half way to the centre; their edges are decorated with two rows of granulose spinules. Diaphragms numerous, partially flat, partially convex, forming a monticulose projection with spinulose or granulose surface. Pores large and abundant.”

*Formation and Localities*—In the Niagara group at Charleston Landing, and other localities in Indiana, and at numerous localities throughout the western extension of this formation.

FAVOSITES, *Lamarck.*

## FAVOSITES FAVOSUS.

*Plate 3, Figs. 1-4.**Calamopora favosa*, GOLDFUSS. Petref. Germ., 1826.*Calamopora favosa*, (Goldfuss), VAN CLEVE MSS., 1853.*Favosites favosus* (Goldfuss), WHITE. Geology and Nat. Hist. of Ind., 11th Report, p. 383, 1881.

This species was previously identified among the plates of Mr. Van Cleve by Dr. C. A. White. The figures above referred to serve to illustrate this common and characteristic coral of the Niagara group.

## FAVOSITES (ASTROCERIUM) VENUSTUS.

*Plate 2, Figs. 7, 8.**Astrocerium venustum*, HALL. Pal. N. Y., vol. 2, p. 120, pl. 34, 1852.

VAN CLEVE MSS., 1853.

The figures on plate 2, referred to this species, represent its ordinary characters. Figure 7 shows the cell apertures somewhat enlarged.

SYRINGOPORA, *Goldfuss.*

## SYRINGOPORA VERTICILLATA.

*Plate 3. Fig. 5.**Syringopora verticillata*, GOLDFUSS. Petref. Germ., 1826.*Syringopora verticillata*, (Goldfuss,) VAN CLEVE MSS., 1853.

“Large aggregations of parallel or diverging tubular stems, from two to three millimeters in diameter, keeping a distance of from two to five millimeters apart, across which they connect at various not very close intervals by narrow, transverse, branch tubules, of which two or three are always sent off at nearly the same height, but not in true verticillate position. The tubes are filled by invaginated, irregularly funnel-shaped diaphragms, attenuated at the lower ends into long siphons. The longitudinal rows of spinules are rarerly well preserved in the tubes of the specimens which are all found in silicified condition. The colonies of stems are often large, several feet in diameter; their basal portions, composed of prostrate, irregularly reticulated expansions of stems, differ considerably from the erect parts, and among the specimens of colonies a great many variations occur as regards the size of the tubes or their mode of growth. In some the stems are distant, in others near; in some perfectly straight, in others flexuose or geniculated with regular verticillate side connections or with dispersed side arms branching off at remote intervals or in closer proximity.” (Rominger Geol. Survey, Michigan, pal. p. 80.)

The description and observations of Mr. Van Cleve on this species are of value and interest, and are here repeated in full.

“*Syringopora with straight, remote tubes; small connecting tubes sub-verticillate.*

“The cylindrical, perpendicular and parallel tubes have the thickness of a stout raven quill and have the partitions within them close together. The side connecting tubes are almost verticillate. *Calcareous petrefaction, from Drummond's Island, Lake Huron.*

“*Gravel, Dayton.* In the specimens found here, there is more regularity in the positions of the whorls, than in the one figured by Goldfuss, their perpendicular distances from each other being less and more uniform and their horizontal extensions being almost in perfect planes. In consequence of this, the coral has the form and appearance of a very regular scaffolding.”)

*Formation and Localities.*—Specimens may be met with at any of the productive localities of the Niagara limestone.

AULOPORA, *Goldfuss*.AULOPORA VANCLEVII, *N. Sp.*

Plate 4; Figs. 1, 2.

*Aulopora serpens*, (Goldfuss), VAN CLEVE MSS., 1853.

From the description and figures of Mr. Van Cleve, we are led to consider his specimens as having been found in the Niagara Group of Indiana, and therefore differing from *A. serpens* belonging to the Devonian. His description is as follows:

“*Aulopora* incrusting, creeping; tubes narrow, proliferous from the side of the apex alternately or connected in network; orifices contracted, opening upward.

“The straight obconic tubes are proliferous near their upper ends, just below their mouths, which are round, slightly contracted and curved upwards. Either one tube sprouts from the preceding one, or two of them put forth, which then recede from each other in a fork, and then frequently unite again like a net by new sprouts and form meshes of different shapes and sizes.”

There are specimens in the State collection from the Falls of the Ohio and vicinity, which agree very well with the above description and the figure on plate 4. *Aulopora serpens* is a much larger form, although of similar growth.

*Formation and Localities*.—Niagara Group, Indiana and Kentucky.

ERIDOPHYLLUM, *Edwards & Haime*.

## ERIDOPHYLLUM RUGOSUM.

Plate 3, Fig. 6.

*Eridophyllum rugosum* E. & H. Mon. Pol. Foss. des Terr. Pal. 1851.*Lithodendron larviformis*, VAN CLEVE MSS., 1853.

Cæspitose masses of cylindrical stems. Stems about ten millimeters in diameter, parallel, flexuous, with marked constrictions and numerous lateral, acanthiform processes of attachment. Lamellæ forty to fifty in each cup, crenulated.

*Formation and Localities*.—Quite common in the Niagara group of Indiana and Kentucky.



## CORNIFEROUS LIMESTONE.

### FAVOSITES, *Lamarck*.

#### FAVOSITES EMMONSI.

*Plate 4, Figs. 3, 4.*

*Emmonsia hemispherica*, E. & H. Monog. Polyp. Foss. Terr. Pal. 1851.

*Calamopora* —, VAN CLEVE MSS., 1853.

*Favosites emmonsi*, ROMINGER. Fossil corals, p. 27. 1876.

*Favosites emmonsi*, HALL. Illustrations of Devonian Fossils, pl. ix. 1876.

The original description of this species, loc. cit., is as follows:

“Tubes unequal, rounded-polygonal, from one to one and a half millimeters in diameter. Tube channels longitudinally striate by a cycle of twelve furrows; of the intermediate band-like spaces, each one bears a vertical row of horizontal squamæ, which are in alternating position in the adjoining rows. Diaphragms rarely simple, straight, generally composed of anchylosed, lateral squamæ, presenting an angular, substellate surface; or the interlacing squamæ remain free, and constitute imperfect septa instead of complete transverse diaphragms. Pores large, forming in single or double, or even triple rows on each side, according to its width, and in places they are much more numerous than in others. It is often noticeable that tubes, for a certain part of their length, are intersected by simple, straight diaphragms, without complication by lateral squamæ, and again, both above and below, are found divided by very irregularly interlacing compound septa. This form grows in large convex masses, or in discoid expansions, with a concentrically wrinkled epitheca on the lower side.”

*Formation and Localities.*—This species is common in the Corniferous limestone of Indiana, and is also found in Kentucky, Ohio, Michigan, New York and Canada.

#### FAVOSITES LIMITARIS.

*Plate 4, Figs. 5, 6.*

*Calamopora spongites* (Goldfuss), VAN CLEVE MSS., 1853.

*Favosites limitaris*, ROMINGER. Foss. Corals, p. 36. 1876.

“Ramified and reticulated stems, from five to fifteen millimeters in thickness, forming horizontally explanate expansions or erect fruticose ramifications. Tubes very thick walled, opening nearly rectangularly to the surface, with circular orifices, the walls forming either a solid, undefined interstitial mass; or,

in another state of preservation, the polygonal outlines of each tube are visible on the surface of the interstices as delicate engraved lines. Several varieties are observed in regard to the mode of growth, and the size of the tubes. The tube orifices rarely exceed the diameter of one millimeter; often they are smaller, and in some forms they are all equal in a specimen. Others have smaller and larger orifices intermingled. A part of the orifices of the side faces of the stems are often found closed by opercula, situated below the outer edge of the channels; in the interior parts of the tube channels diaphragms are not regularly developed, and are of rare occurrence. Pores large, distant, and irregularly dispersed. In older stems the tube channels not unfrequently become considerably narrowed by excessive incrassation of the tube walls, while the pore channels gain in length and width, and appear on the surface as vermicular, transverse channels connecting the tube channels, which latter are, in their narrowed condition, hardly larger than the connecting pore channels." (Rominger, *Fossil Corals*, p. 36.)

*Formation and Localities.*—Common to the Corniferous limestone in Indiana, Kentucky, Michigan, New York and Canada.

#### FAVOSITES HEMISPHERICUS.

*Plate 5, Figs. 1, 2.*

*In part Calamopora alveolaris* (Goldfuss), VAN CLEVE MSS., 1853.

*Favosites hemisphericus*, YANDELL & SHUMARD. *Contributions to the Geology of Kentucky*. 1847.

*Favosites hemisphericus*, ROMINGER. *Fossil Corals*, p. 25, pl. vi. 1876.

*Favosites hemisphericus*, HALL. *Illustrations of Devonian Fossils*, pl. ii. 1876.

*Favosites turbinatus*, BILLINGS. 1859.

*Not Favosites hemisphericus*, EDWARDS & HAIME. 1851.

The description of this species, as limited and amended by Dr. Rominger, is as follows:

"The tubes of this form are about two millimeters in diameter, of unequal size, rounded polygonal. Tube cavity generally smooth, intersected by simple flat diaphragms. It occurs rarely that the diaphragms are compound and angular on the surface, formed by ankylosis of lateral squamiform projections. Lateral pores large, usually in a single row on each side, and moderately distant. Sometimes, however, two rows of pores may be observed on a side. The mode of growth mentioned is the most characteristic feature of this species is, nevertheless, quite variable. We find polyparia of subspherical or of bi-convex lenticular form, or in cylindrical, irregularly flexuose, root-like masses, over a foot in length, or in elongated horn-

shape, all of which forms proceed from a single proliferous mother-tube. At first the polyparium is attached by its narrow and usually excentric apex, but soon it becomes free, and the apex is folded over by the spreading margins of the rapidly enlarging corallum. The tubes diverge in graceful curves from an imaginary central axis toward the periphery. Those ends terminating on the lateral faces of the corallum, have their walls thickened in their peripheral portion, and their orifices are all closed by opercula of concentric annular structure, with a central opening while growing, which is finally closed by a solid nodular piece. The margins of the opercula are frequently decorated by twelve carinæ converging from the margins toward the centre, but not reaching it. In specimens with excessively thickened wall substance, these radial carinæ are very obscure or entirely obliterated. The orifices terminating on the convex disk of the corallum are all open, more thin walled than the others, and of more pronounced polygonal form. It often happens that these centrally situated, thinner walled tubes have been destroyed by weathering, while the exterior lateral tube ends, of massive structure, have resisted and been preserved. The upper end of such specimens is deeply excavated, and the lenticular forms are transmuted into concave, patelliform dishes. The elongated, horn-shaped specimens terminate in this case with a funnel-shaped excavation resembling the calyx of a *Cyathophyllum*, which resemblance is augmented by the exposure of the side faces of the septate tubes, arching from the center to the periphery, which bear a descriptive likeness to the radial lamellæ, with intermediate vesicular cell spaces of the calyx of a *Cyathophyllum*." (Rominger, *Fossil Corals*, p. 25.)

*Formation and Localities.*—Common in the Corniferous limestone of Indiana, and throughout the extent of this formation in other States and in Canada.

## SYRINGOPORA, *Goldfuss*.

### SYRINGOPORA PERELEGANS.

*Plate 7, Fig. 1.*

*Syringopora caespitosa*, (Goldfuss) VAN CLEVE MSS., 1853.

*Syringopora perelegans*, BILLINGS. *Can. Jour.*, N. S., vol. iv. 1859.

*Syringopora perelegans*, (Billings) WHITE. *Geol. Surv. Indiana*, 11th Report, p. 398. 1881.

The original description of this species is given in the previous report. The present figure represents a compact mass of

corallites and agrees with the description of Billings, and the figures and description given by Dr. Rominger in his work on the fossil corals. The figure on plate 49 of the 11th Report, represents the tubes as considerably larger than usual with *S. perelegans*, and may represent another species.

## HELIOPHYLLUM, *Hall*.

### HELIOPHYLLUM HALLI.

*Plate 6, Fig. 1.*

*Heliophyllum halli*, E. & H. Brit. Foss. Corals. 1850.

*Cyathophyllum turbinatum*, (Goldfuss) VAN CLEVE MSS., 1853.

“*Corallum* simple, turbinate, or cylindro-conical, usually elongate, and slightly curved at its base, provided with an epitheca, and presenting slight circular swellings. *Calice* circular, rather deep, with a small septal fossula. *Septa* (80 or even more) very thin, closely set, rather broad at their upper end where they are arched and denticulate, alternately larger and smaller, slightly twisted near the center of the visceral chamber. A vertical section shows that the lateral processes of the septa are arched and ascendant; those situated toward the upper end of the corallum terminate at the edge of the septa; those situated lower down unite near the center of the visceral chamber, so as to constitute irregular *tabulae*. The interseptal loculi are filled up with these lamellate processes, which are situated at about half a line apart, and united by closely-set simple dissepiments that form right angles with them. Diameter of the calice from 1 to 2 inches.”

[Edwards & Haime, monograph of the British Fossil Corals, 4th part, p. 235, 1853.]

Mr. Van Cleve's engraving gives a good representation of a fine specimen of this species.

*Formation and Localities.*—Common in the Corniferous limestone and Hamilton group of Indiana, Kentucky, Ohio, Michigan, New York and Canada.

### HELIOPHYLLUM COALITUM.

*Plate 7, Figs. 2, 3.*

*Cyathophyllum helianthoides*, (Goldfuss) VAN CLEVE MSS., 1853.

*Cyathophyllum coalitum*, ROMINGER. Fossil Corals. 1876.

“*Astræiform* masses of very large, polygonal polyp cells measuring about four centimeters in diameter, each one sur-

rounded by its own complete wall. Surface of calyces expanded, discoid, with an abrupt but shallow central pit, the reversed bottom of which conically projects, covered by the central ends of the radial crests. Lamellæ linear, sub-equal, from sixty to seventy in the circumference of a calyx, crenulated by transverse trabeculæ (bars), which are the ends of lateral, arched carinæ decorating the side faces; about fourteen carinæ on the length of one centimeter. Interstitial spaces filled with vesicles arranged in arched rows running diagonally across the carinations. Central area traversed by transverse, larger plates, which are much intersected by the vertical lamellæ." (Rominger, *Fossil Corals*, p. 108. 1876.)

*Formation and Localities.*—Frequently found among drift specimens from the Corniferous limestone.

Mr. Van Cleve has identified the simple and compound forms as one species, which he describes as follows:—“*Cyathophyllum* solitary or cæspitose; terminal cell with margin broad, somewhat reflexed; in cæspitose specimens pentagonal; center widely umbilicate; rays in pairs, uniting in a disk.”

It may be doubtful whether the simple and compound specimens are specifically identical.

## CYATHOPHYLLUM, *Goldfuss.*

### CYATHOPHYLLUM RUGOSUM.

*Plate 8, Figs. 1, 2.*

*Astrea rugosa*, HALL. *Geol. Rept. 4th Dist., N. Y., 1843.*

*Cyathophyllum rugosum*, E. AND H. *Mon. Pol. Foss. des Terr. Palæoz, 1851.*

*Cyathophyllum hexagonum* (Goldfuss), VAN CLEVE. *MSS., 1853.*

“Astræiform colonies of polygonal, intimately united stems of a diameter from one to one and a half centimeter, which, in some specimens of a certain state of preservation, are separable, and present longitudinally ribbed polygonal stems, annulated by transverse wrinkles of growth. Calyces joining, with gradually ascending side walls, inclosing conical cell pits; or the end cells are formed by an abrupt, narrow, central pit, with horizontally expanded, discoid margins. The bottom of the cells is sometimes formed by diaphragms with a smooth central spot; usually the lamellæ reach to the center and intermingle there, forming a twisted knot. Number of lamellæ in the circumference of the calyces, from 35 to 45. Their edges are crenulated, the side faces traversed by arched carinæ, which, in some specimens, are almost obsolete; in others, very distinct.

Interlamellar interstices, traversed by small vesicles, filling them to the margins of the calyces. The center of the stems is transversely septate by diaphragms, intersected in their outer circumference by continuous vertical lamellæ; centrally their continuity is interrupted, and the ends are merely carinaceous on the upper face of the diaphragms." (Rominger, *Fossil Corals*, p. 106, 1876.)

*Formation and Localities.*—Common in the Corniferous limestone, in Indiana, Kentucky, Ohio and other localities.

### DIPHYPHYLLUM, *Lonsdale.*

#### DIPHYPHYLLUM STRAMINEUM.

Plate 9, Fig. 2.

*Diphyphyllum stramineum*, BILLINGS. *Canadian Journal N. S.*, vol. iv, 1859.

*Diphyphyllum stramineum*, WHITE. *Geol. Rept. Indiana*, 11 Report, p. 388. 1881.

*Lithodendron flexuosum*, VAN CLEVE MSS., 1853.

This species was identified among the engravings of Mr. Van Cleve, by Dr. White, in a previous report. The present figure represents a more compact form of the species.

*Formation and Localities.*—Corniferous limestone, Indiana, and in numerous other localities for this formation.

### ERIDOPHYLLUM, *Edwards & Haime.*

#### ERIDOPHYLLUM VERNEUILIANUM?

Plate 8, Fig. 3.

*Eridophyllum Verneuilianum*, E. & H. *Mon. Pal. Foss. des Terr. Pal.*, 1851.

*Eridophyllum Verneuilianum*, NICHOLSON. *Pal. Ohio*, vol. ii, p. 239.

*Lithodendron verticillatum*, VAN CLEVE MSS., 1853.

"Corallum composed of cylindrical, straight, or slightly flexuous corallites, which have a diameter of from four to six lines, and are united by horizontal connecting processes placed at intervals apart of from half an inch to one inch and a half. Septa usually about forty-five in number, alternately large and small, extending very nearly to the centre of the visceral chamber, and thus invading the central tabulate area. The septa are united in the outer zone of the corallites by numerous delicate dissepiments. The distance between the different corallites varies much, being sometimes as much as half an inch, whilst at other times the corallites are nearly in contact." (Nicholson, *Pal. Ohio*, vol. ii, p. 239.)

*Formation and Localities.* Corniferous limestone, Indiana, Kentucky and Ohio.

## ERIDOPHYLLUM SIMCOENSE.

Plate 9, Fig. 1.

*Eridophyllum Simcoense*, BILLINGS. Can. Jour. N. S., vol. iv, 1859.  
*Lithodendron vermiculare*, VAN CLEVE MSS., 1853.

“Corallum forming colonies of cylindrical, straight, flexuous, or crooked corallites, from two to three lines in diameter, distant from one another from one to three lines, and united by short horizontal connecting processes at intervals varying from two to six lines. The connecting processes are thick where they spring from the wall of the corallite, thin in the middle, and again thick where they join the contiguous corallite; and they are often, though by no means universally, all turned the same way in the same colony. The surface usually exhibits encircling folds of growth, along with vertical ridges corresponding with the septa. There is a well developed central tabulated area, into which the septa penetrate slightly, or not at all. The septa are between forty and fifty in number, alternately large and small.”

“Typical examples have the corallites straight, with the connecting processes placed at tolerably uniform distances, but many examples occur in which the corallites are very crooked, and the intervals between the connecting processes extremely variable. Increase by parietal gemmation, the young individual bending upwards and becoming parallel with the older corallites, is a phenomenon which can commonly be observed.” (Nicholson. Palæontology of the Province of Ontario, p. 34, 1874.)

*Formation and Localities.*—Common in the Corniferous limestone at numerous localities throughout its extent.

CYSTIPHYLLUM, *Lonsdale*.

## CYSTIPHYLLUM PUSTULATUM.

Plate 9, Figs. 3, 4? 5?

*Cystiphyllum pustulatum*, HALL. Foss. Corals Niag. and Up. Held. groups. In advance of Museum Report, p. 58. 1882.

*Cystiphyllum vesiculosum*, (Goldfuss) VAN CLEVE MSS., 1853.

Among the forms of *Cystiphyllum* figured by Mr. Van Cleve and referred by him to *C. vesiculosum* (Goldfuss), are the figures given on plate 9. Figure 3 represents the form and dimensions of *C. pustulatum* (Hall), of which the following is the original description:

“Corallum simple, turbinate, more or less rapidly expanding; proportional height and diameter varying; in some individuals of thirty-five millimeters in height the diameter of the calyx is fifty-five millimeters, in others, having a height of eighty millimeters, the diameter of the calyx is forty millimeters; exterior comparatively smooth, with concentric wrinkles and striæ, and distinct external costæ; calyx from twenty to thirty-five millimeters in depth, for a short distance from the margin, flat or gently curving, then abruptly and regularly sloping to the center; the entire surface of the calyx shows prominent cysts from one to three millimeters in diameter, increasing but little, if any, in size toward the center; occasionally a cyst occurs much larger than the ordinary ones; surface of the cysts marked by moderately coarse, interrupted striations. This species is the only one from this locality in which the cysts are not more or less interrupted by the rudimentary lamellæ.”

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

## STROMATOPORA, Goldfuss.

### SYRINGOSTROMA, Nicholson.

#### STROMATOPORA (SYRINGOSTROMA) DENSUM.

*Plate 10, Fig. 7.*

*Syringostroma densa*, NICHOLSON. Pal. Ohio, vol. ii, p. 251, 1875.

*Agaricia boletiformis*, (Goldfuss), VAN CLEVE MSS., 1853.

The figure given, represents, in a measure, the characters described and illustrated in the original description of the species contained in vol. ii, of the Palæontology of Ohio, as follows:

“Sarcodeme apparently forming irregular masses or thick crusts, composed of an exceedingly dense calcareous tissue containing very minute cells. This tissue is probably essentially composed of successive concentric laminæ, separated by vertical dissepiments; but its density is so great that it may be regarded in practice as a mass of laminated calcareous matter in which excessively small but numerous cellular compartments are excavated. Not only are these cells extraordinarily small, but they are only now and then arranged in horizontal lines, and they often assume the form of minute tubuli passing through more than one layer. Hence it is impossible to count the number of laminæ or rows of cells in a given vertical space, and it can only be said that the mass is denser and the cells more minute than in any known species of stromatopora,



whilst, nevertheless, the composition of the whole out of concentric laminae is very conspicuous. The mass is traversed by numerous very irregularly disposed horizontal canals which run nearly parallel with the surface, have a diameter of usually from one-fifth to one-fourth of a line, and are placed at intervals apart of from one-third of a line to about one line. The upper surface exhibits two distinct sets of apertures—*firstly*, a series of very minute and crowded perforations, which doubtless correspond with the cells of the mass; and, *secondly*, a larger set of apertures, which are very irregularly distributed, and are likewise very numerous. These latter apertures are circular, have a diameter of from one-eighth to one-fifth of a line, are placed at intervals of from one-fourth to one-half line apart, and are almost certainly the apertures of a series of vertical canals.

“As regards the additional characters of the surface, the specimens differ so materially that I can not with certainty affirm that they belong to the same species. In the most typical examples the surface is undulating, and exhibits numerous star-like, not elevated, impressions, formed of vermicular bifurcating horizontal canals, which radiate from a central point. When partially decorticated, it is seen that these radiating canals have a distinct calcareous lining, and, whilst in the main horizontal, some of them penetrate the mass obliquely, and thus pass below the actual surface. The diameter of these star-like impressions is about half an inch, or rather less; they are placed close together over the whole surface.”

In the description given by Mr. Van Cleve he says: “The upper surface has confluent, irregularly scattered stars of unequal size.” Taken in connection with his figure it seems evident that he had specimens of the species described by Professor Nicholson in the Palæontology of Ohio.

*Formation and Localities.*—Found in the Corniferous limestone in its extent through Ohio and Indiana.

BRYOZOA.  
HUDSON RIVER GROUP.  
PTILODICTYA, *Lonsdale*.

PTILODICTYA FALCIFORMIS.

*Plate 12, Fig. 1.*

*Ptilodictya falciformis*, NICHOLSON. Pal. Ohio, vol. ii, p. 259. 1875.

*Ceriopora ensiformis*, VAN CLEVE MSS., 1853.

“Polyzoary consisting of a single unbranched, or slightly branched, elongated, flattened, narrow, and two-edged frond, the form of which is more or less curved and falciform, and which gradually expands from a pointed base till it reaches a width of two lines within a distance of less than half an inch above the base. The total length may exceed two inches, but the width rarely or never exceeds two and a half lines. The transverse section is acutely elliptical, the thickness in the middle not exceeding half a line, and the flat faces of the frond are very gently curved, and are not angulated. No central axis can, as a rule, be made out with certainty, though the existence of such can sometimes be demonstrated. The edges of the frond are thin and sharp, formed by a narrow band, which is longitudinally striated, and, when perfect, is perforated by the apertures of minute imperfect cells, which have a longitudinal direction. Both sides of the frond are celluliferous, the cells being apparently perpendicular to the surface, and being arranged in intersecting diagonal lines, which form angles of about thirty degrees with the sides of the frond, and thus cut one another at sixty degrees. The mouths of the cells are oval, or somewhat diamond-shaped, their long axis coinciding with the axis of the frond, alternately placed in contiguous rows, about eight in the space of one line measured diagonally, and ten in the same space measured transversely, the outermost rows very slightly smaller than the others. Walls of the cells moderately thick; no surface-granulations, tubercles, spines, or elevated lines. The mouths of the cells parallel with the general surface, neither lip being especially prominent, and the plane of the aperture not being oblique.” (Nicholson, Pal. Ohio, vol. ii, p. 259. 1875.)

*Formation and Locality.*—Hudson River group in Ohio, and also found in the same horizon in Indiana.

## CLINTON GROUP.

## PTILODICTYA EXPANSA.

Plate 12, Figs. 2, 3.

*Phanopora (Ptilodictya) expansa*, H. & W. Pal. Ohio, vol. ii, p. 114. 1875.*Flustra lanceolata*, (Goldfuss) VAN CLEVE MSS., 1853.

“FronD forming broad, elongate stipes, the entire length and form not determined, the larger fragments seen measuring nearly an inch in width by nearly two and three-quarter inches in length, with a thickness of an eighth of an inch. The lateral edges are slightly irregular, but generally parallel in the specimens under consideration. FronD distinctly separated longitudinally into two parts by a thin, central partition, extending from edge to edge, from the surfaces of which the cells take their origin, and diverge obliquely upward and outward to the surface of the frond.

“Surface of the frond divided by thin, longitudinal partitions, forming the sides of the cells, and separating them into longitudinal rows. The outer edges of the partitions are slightly raised above the upper and lower walls of the cells, and count ten or eleven in the space of a tenth of an inch. Cells slightly oval, a little longer than wide, arranged in horizontal, or nearly horizontal rows, diverging from the central partition at an angle of about fifteen degrees above a horizontal, but varying somewhat in different parts of the frond. There is an appearance of maculæ, or slightly elevated patches, on the surface, but they are not sufficiently distinct to determine their order or arrangement.” (Hall & Whitfield. Pal. Ohio vol. ii, p. 114. 1875.)

Mr. Van Cleve evidently had very large and fine specimens of this and other species of bryozoans from the Clinton group of Dayton, Ohio. One of the illustrations shows the rounded and somewhat pointed termination of the fronds and their uniform width.

*Formation and Locality.*—In the yellow limestone of the Clinton group, near Dayton, Ohio. The term Clinton group for these limestones is used in deference to the Ohio Reports, and was also the position assigned to these rocks by Mr. Van Cleve. They may constitute a member of the Niagara group.

PTILODICTYA [SUB GENUS?] BIPUNCTATA (*Van Cleve*), *N. Sp.*

Plate 13, Fig. 5.

*Eochara bipunctata*, VAN CLEVE MSS.

The following description is taken from the manuscript of Mr. Van Cleve, and, in connection with the figure, serves to

characterize this fine species in a very satisfactory manner. The lobate form of one of the fronds is not incompatible with the genus, and has been noticed in *P. falciformis*, Nicholson:

“*Eschara* spreading, leaf-like or lobed, flat; cells oval, in longitudinal ranges; end-borders of the cells bi-punctate.

“Thin, flat-spread, double membranes, of various forms, commencing with a narrow base and widening more or less, sometimes forming two lobes. The cells lie in longitudinal ranges, generally somewhat curved, running from the narrow base to the upper margin of the membrane, diverging frequently to make room for the intervention of new ranges as the fossil widens. The cell-mouths do not lie in regular ranges obliquely or crosswise, being in some places opposite to each other, and in others alternate. Two opposite dot-like cavities are formed in each space between the cells, as they succeed each other in the longitudinal ranges.”

*Formation and Locality.*—In the limestone of the Clinton group, Dayton, Ohio.

### STICTOPORA, *Hall.*

#### STICTOPORA COMPRESSA, *N. Sp.*

*Plate 14, Fig. 3.*

*Eschara compressa*, VAN CLEVE MSS., 1853.

“*Eschara* branching, compressed; branches broad, their edges without cells; cells oval, perpendicular.

“Compressed, broad, branching stems. The cells are larger and deeper than in any of the preceding species. They lie in longitudinal ranges, are oval, and are sunken perpendicularly to the surface of the stem. A portion of the thin edge of the stem is without cells.”

*Formation and Locality.*—Clinton group, Dayton, Ohio.

#### STICTOPORA BIFURCATA, *N. Sp.*

*Plate 13, Figs. 3, 4.*

*Eschara bifurcata*, VAN CLEVE MSS., 1853. -

“*Eschara* forked, compressed, slightly channeled; branches slender; cells with oval mouths, in longitudinal ranges, and in oblique cross-ranges.

"Compressed slender forked twigs, which are slightly channeled lengthwise and have their cells in the channels. The cells are oval and very uniform in size and shape. A small cone is frequently seen in the bottom of a cell."

*Formation and Locality.*—Clinton group, Dayton, Ohio.

STICTOPORA VANCELVII, *N. Sp.*

Plate 13, Figs. 1, 2.

*Eschara ramosa*, VAN CLEVE MSS., 1853.

not *Stictopora ramosa*, HALL. Pal. N. Y., vol. i, 1847.

"*Eschara* spreading, branching; branches in one plane, narrow; cells with oval mouths, imbricate, in oblique ranges."

"Thin, flat, narrow, branching stems, the numerous ramifications being all in one plane. The cells form longitudinal ranges, and lie over each other in oblique cross rows, their oval mouths diverging somewhat from the middle of each branch toward the edge."

*Formation and Locality.*—In the limestones of the Clinton group, at Dayton, Ohio.

STICTOPORA MULTIFIDA, *N. Sp.*

Plate 14, Fig. 4.

*Eschara multifida*, VAN CLEVE MSS., 1853.

"*Eschara* spreading, fan-shaped, divided into numerous, narrow, contiguous lobes; cells oval, imbricate, in oblique ranges."

"Thin, fan-shaped, flat spread, double membranes, pedately cut into numerous divisions, which divide again and again, each branchlet, after every sub-division, having a breadth equal to that of its parent branch. The branches and their subdivisions each have about ten longitudinal ranges of cells, lying over each other in oblique cross ranges, and having slightly oval mouths."

This species somewhat resembles *S. magna*, Hall & Whitfield, from the same horizon, but has not the horizontal arrangement of the cell-pores, the microscopic pores at the base of each cell-aperture, and the branches are considerably smaller than in that species. The figure illustrates very well the size and manner of growth of this unusually fine species.

*Formation and Locality.*—In the yellow limestone of the Clinton group at Dayton, Ohio.

RETEPORA, *Lamarck*.

## RETEPORA ANGULATA.

Plate 14, Figs. 1, 2.

*Retepora angulata*, HALL. Pal. N. Y., vol. ii, p. 49. 1852.

*Retepora producta*, VAN CLEVE MSS., 1853.

“Fronnd much expanded (perhaps cyathiform originally); branches anastomosing; fenestrules large, very oblong, oval or irregularly sub-rhomboidal, varying in size; non-poriferous face striated; poriferous face with two or three rows of pores on each branch; pores small, round, salient, papilliform.” (Hall, Pal. N. Y., vol. ii, p. 49.)

The specimens which were described by Mr. Van Cleve showed that the entire form of the frond was cup-shaped or infundibuliform.

*Formation and Locality*.—Limestone of the Clinton group, Dayton, Ohio.

NOTE.—I have been requested by Dr. C. A. White to make some corrections in the references of figures to certain species of the Van Cleve corals, described by him in the Eleventh Report of the State Geologist of Indiana. The references and comments herewith communicated are not to be understood as made in any captious spirit, but as expressions of my own judgment regarding the proper relations of certain illustrations; which I submit with due deference to the opinions of others.

Those who were familiar with the labors of Mr. Van Cleve during his life time, know that one of his principal objects was the identification of the American Palaeozoic corals with the figures and descriptions of Goldfuss; and this fact will, I think, offer a sufficient explanation for the statements I have made in the following paragraphs.

Plate 45, figs. 1, 2, page 393, *Amplexus vandelli*. Figs. 1 and 2 are not good representations of the species as known to us. *Zaphrentis rafinesqui*, figs. 3, 4, 5, represent different species; fig. 4 is apparently a *Heliophyllum*. Figs. 1, 2, 3 may represent *Zaphrentis undata*, page 291, plate 20, figs. 7 and 8; and plate 25, fig. 1, of this Report.

Plate 47, figs. 1, 2, page 396, *Fistulipora canadensis*. Fig. 1 has the circular apertures too regular and equidistant to represent *F. canadensis*, while the intermediate space does not show the angular apertures, which are so conspicuous in that species. (See Rominger, Fossil Corals, Plate VIII.) The figure 1 represents a species of *Syringopora*, apparently *S. tubulata*. Fig. 2 is probably a representation of *Favosites venustus*.

Plate 47, figs. 3, 4, page 399, *Syringopora Maclurei*. The corallites are too small and too closely arranged to represent this species as usually known. The figure has a nearer resemblance to *S. perelegans*, but is less diffuse. Compare *Syringopora reticulata*, Goldfuss, XXV, fig. 8.

Plate 47, fig. 7, is much larger than the ordinary forms of *Striatopora Linnæana*, and may represent another form of the genus. The figure appears to me to have been in part derived from fig. 5, plate XXVII, of the Petrefacta Germania, which the author describes under *Calamopora polymorpha*, “var. *gracilis*, ramis *gracilibus elongatis*.”

Plate 48, fig. 1, probably represents *Diphyphyllum arundinaceum*, with some modifications in the illustration intended to conform the expression to the species of Goldfuss, with which it had been identified by the author.

Plate 49, fig. 1, page 396, represents *Eridophyllum Verneuilianum*.

Plate 49, fig. 3, page 398, *Syringopora perelegans*. This figure does not represent *S. perelegans*. In size, the corallites approach those of *S. muclurei*, but they are too compactly arranged, and in this respect, as well as in size, more nearly represent certain conditions of *S. verticillata* of the Niagara group.

Plate 50, fig. 1, page 387. This illustration is undoubtedly intended to represent *Diphyphyllum Archiaci*, but has been made to conform in some degree to the figure of *Cyathophyllum cæspitosum* of Goldfuss, and presents the corallites in too close proximity.

Plate 50, fig. 2, page 395, *Favosites polymorpha*. The figure is evidently copied, in a reversed position, from fig. 3a, plate XXVII of Goldfuss' Petrefacta, and is the "var. *tuberosa*, *tubis minoribus gracilibus*" of Goldfuss. It is not unlike some varieties of form of the *F. hemispherica*, which is a very polymorphous species and, perhaps, the nearest representative which we have to the European *F. polymorpha*.

Plate 51, fig. 1, page 389, *Diphyphyllum arundinaceum*. The figure does not represent any ordinary form of this species, and it may well be doubted if it represents any American Devonian coral. The figure was apparently intended by Mr. Van Cleve as a representation of *Lithodendron cæspitosum* of Goldfuss, which is cited by him as occurring at Bensburg, Germany, and Dayton, Ohio.

Plate 51, figs. 2, 3, 4, page 376, "*Streptelasma corniculum*." Figs. 2 and 3 represent *Zaphrentis canadensis*, Billings.

Plate 52, figs. 1, 2, page 383. Fig. 1 apparently represents *Favosites epidermatus*, Rominger. Fig. 2 may be of that species, or of some other form from the Corniferous limestone.

Plate 53, figs. 1, 2, page 395. Fig. 1 is evidently copied from fig. 2a, plate XXVII of Goldfuss' Petrefacta, and is the variety of *Calamopora polymorpha* designated by that author as "var. *tuberosa*, *tubis maioribus et elongatis*." The American form most nearly allied to this may be found among the varieties of *F. hemispherica*. Fig. 2 is copied from the same author, fig. 3, plate XXVII, and is arranged by him under "var. *tuberosa-ramosa*, *tubis minoribus gracilibus*." This figure would compare very well with forms of *F. hemispherica* known in Ohio and Indiana. Plate 53, fig. 3, page 396, *Favosites polymorpha*, var. *dubia*. This figure of Mr. Van Cleve is evidently copied, with modifications, from the figure 4a, plate XXVII, of Goldfuss. The lower part of the original has been left out. This form is placed by Goldfuss under *Calamopora polymorpha*, "var. *ramosa-divaricata tubis obovaticis*," and with fig. 4b of the same plate, has much resemblance to some of our branching forms of *Favosites*.

Plate 54, fig. 1, page 394. The figure of Mr. Van Cleve is evidently copied from plate XXVII, fig. 1a of Goldfuss' Petrefacta, and is the *Calamopora infundibulifera* of that author. The figure closely resembles some forms of *Favosites tuberosa*, Rominger, from the Corniferous limestone of the West.

Plate 54, figs. 2, 3, pages 396 and 397. These figures represent the upper and lower sides of *Alveolites Goldfussi*.

Plate 55, figs. 1, 2, page 391, *Cystiphyllum vesiculosum*, does not represent that species, and is apparently closely allied to *Cystiphyllum infundibulum*, and *C. crateriforme*, Hall, Fossil Corals of the Upper Helderberg group, pages 57 and 58, 1882.

DESCRIPTIONS  
OF  
FOSSIL CORALS FROM THE NIAGARA AND UPPER  
HELDERBERG GROUPS OF INDIANA.

BY PROFESSOR JAMES HALL.

The limestones of the Niagara and Upper Helderberg Groups, in Southern Indiana, the falls of the Ohio, and adjacent portions of Kentucky, have proved extremely prolific in numerous forms of fossil corals. Some of these forms were described by Rafinesque and Clifford, and by Lesueur, as early as 1820; others were described by Troost from 1840 to 1844. A considerable number of species from this region were described by Edwards and Haime in 1851, and these constitute an interesting and important feature in their "*Descriptions des Polypiers Fossile des Terrains Palæozoïque.*" More recently (1876) Dr. Rominger has added considerably to the number of described species from this region, and there still remains much to be done before we shall be able to present a complete history of this class of fossils from the Palæozoic rocks of Indiana.

The following described species, most of them of new forms, have been obtained from the following sources, viz.: From the collections made by myself and assistants during several years; from specimens received from Dr. James Knapp and Henry Nettelroth, Esq., of Louisville; by the purchase of an extensive collection from Rev. H. Herzer, embracing specimens from Ohio, Indiana and Kentucky, and finally from collections placed in my hands by the State Geologist of Indiana.



## CORALS OF THE NIAGARA GROUPE.

Genus CHONOPHYLLUM, *Edwards & Haime.*

## CHONOPHYLLUM VADUM.

*Plate 15, Figs. 1-4.*

*Chonophyllum vadum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 6. August, 1882.

Corallum simple, turbinate, straight or slightly curved, acute at the base, regularly expanding to the calyx; exterior with numerous abrupt constrictions and fine concentric striæ; external costæ very distinct; height thirty-five millimeters; diameter of calyx, twenty millimeters; depth ten millimeters; sides slightly concave; a flat space at the bottom five millimeters in diameter; number of lamellæ seventy, flat and of nearly uniform size at the margin, becoming thinner and alternating in size below; the principal ones extending to the center, where they are twisted and very slightly elevated.

*Formation and Locality.*—Niagara group, Louisville, Kentucky.

Genus ANISOPHYLLUM, *Edwards & Haime.*

## ANISOPHYLLUM UNILARGUM.

*Plate 15, Figs. 5, 6.*

*Anisophyllum unilargum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 8. August, 1882.

Corallum simple, turbinate, slender, acute at the base, regularly expanding to the calyx; height thirty millimeters; diameter of calyx twelve millimeters; depth ten millimeters; number of lamellæ fifty, alternating in size, smaller ones rudimentary; commencing at the center and continuing to the anterior margin is an excessively developed lamellæ, which is prominent at the center, becoming less as it approaches the margin, and at nearly right angles to it are two narrow fossettes; the two lamellæ anterior to the fossettes are somewhat more prominent than the others.

*Formation and Locality.*—Niagara group, Louisville, Kentucky.

## ANISOPHYLLUM TRIFURCATUM.

Plate 15, Figs. 7, 8.

*Anisophyllum trifurcatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 9. August, 1882.

Corallum simple, elongate turbinate, slender, very gradually enlarging; exterior with numerous concentric wrinkles and striations; height twenty millimeters; diameter of calyx eight millimeters; depth five millimeters; number of lamellæ fifty-four; three of the lamellæ more prominent than the others, one of which is situated anteriorly, the other two laterally, the remainder alternate in size, the smaller ones extending but a short distance from the margin; some of the lamellæ converge to the three prominent ones, the others to the center of the calyx.

This species may be distinguished from *A. unilargum* by its somewhat more slender form, its thinner lamellæ and the absence of lateral fossettes. The prominent lamellæ are not excessively developed.

*Formation and Locality*.—Niagara group, Louisville, Ky.

CYATHOPHYLLUM, *Goldfuss*.

## CYATHOPHYLLUM INTERTRIUM.

Plate 15, Figs. 9-11.

*Cyathophyllum intertrium*, HALL. Thirty-fifth Annual Report of the N. Y. State Museum of Natural History, advance sheets, page 12. August 1882.

Corallum simple, broadly turbinate, base obtuse, regularly expanding to the calyx; external costæ very distinct; exterior with frequent slender processes, which served for attachment and support; height of corallum fifteen millimeters; diameter of the base seven millimeters; diameter of calyx, eighteen millimeters; depth five millimeters; regularly concave, a space at the bottom flat or slightly curved; tabulæ broad, extending the entire diameter of the corallum. There are thirty prominent thin lamellæ, and between each two of these are three smaller lamellæ; the large ones extend to within from three to five millimeters of the center, leaving a smooth space from six to ten millimeters in diameter.

*Formation and Locality*.—Niagara group, Louisville, Ky.

CYSTIPHYLLUM, *Lonsdale*.

## CYSTIPHYLLUM GRANILINEATUM.

*Plate 15, Fig. 13, and Plate 23, Fig. 13.*

*Cystiphyllum granilineatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 14. August, 1882.

Corallum simple, turbinate, straight or slightly curved, acute at the base, regularly and rapidly expanding to the calyx; exterior with concentric wrinkles and numerous fine but distinct concentric striæ, thirty-five in the space of five millimeters; external striæ very distinct; there are frequent slender processes, serving for attachment and support; when decorticated the cysts are conspicuous; height of corallum twenty-five millimeters; diameter of calyx twenty-five millimeters; depth fifteen millimeters; cysts prominent, varying from one to two millimeters in diameter, covered by rudimentary lamellæ, 120 in number, uniform in size, extending to within two millimeters of the center, and very finely granulated.

This species has a close general resemblance to some of the shorter forms of *C. Niagarensis*, but the lamellæ and denticulations are much finer.

*Formation and Locality.*—Niagara group; Louisville, Kentucky.

HELIOPHYLLUM, *Hall*.

## HELIOPHYLLUM PRAVUM.

*Plate 15, Fig. 12, and Plate 25, Fig. 4.*

*Heliophyllum pravam*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 13, 1882.

Corallum simple, elongate turbinate, curved or tortuous, acute at the base, with frequent constrictions above, not regularly expanding to the calyx; exterior with numerous narrow angular annulations; height of corallum twenty-five millimeters; diameter of calyx ten millimeters; depth five millimeters; some individuals have a greater proportional diameter; calyx campanulate, a flat space five millimeters in diameter at the bottom; fossette dextral, moderately conspicuous at the bottom, becoming obsolete before reaching the margin; number of lamel-

læ fifty, of uniform thickness, alternating in length, rounded at the margin, becoming very thin as they approach the center; the shorter lamellæ continue to the flattened space at the bottom of the calyx, the others to within a short distance of the center, leaving a well defined concave space of two millimeters in length and one millimeter in width, in continuation of the fossette; denticulations thin, prominent, eleven in the space of five millimeters.

*Formation and Locality.*—Niagara group, Louisville, Ky.

### CYATHAXONIA, *Michelin.*

#### CYATHAXONIA HERZERI.

*Plate 15, Fig. 14.*

*Cyathaxonia Herzeri*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 12. August, 1882.

Corallum simple, turbinate, straight or slightly curved, acute at the base, regularly expanding to the calyx; height forty-five millimeters; calyx oblique; diameter thirty millimeters; length of anterior side of corallum fifteen millimeters; columella conical, seven millimeters in height; number of lamellæ about one hundred, alternating in size, the smaller ones about one-third the thickness of the others, which continue to the columella.

*Formation and Locality.*—Niagara group, Louisville, Ky.

### CORALS OF THE UPPER HELDERBERG GROUP.

#### STREPTELASMA, *Hall.*

#### STREPTELASMA COARCTATUM.

*Plate 15, Figs. 15, 16.*

*Streptelasma coarctatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 21. August, 1882.

Corallum simple, turbinate, curved, usually slightly compressed; exterior with broad undulations; height fifty millimeters; calyx slightly oval, greatest diameter twenty-five millimeters; depth twenty millimeters, sides regularly sloping to the

center, an elevation at the bottom five millimeters in height; fossette obscure or wanting; number of lamellæ eighty, near the margin of uniform size, thickened and rounded, on the sides alternating, becoming thin as they approach the center; the principal ones continue to the center, twisting and coalescing. The elevation at the center might be considered as due to tabulæ, but there is no evidence of their existence in the specimens examined.

*Formation and Locality.*—Corniferous limestone, Louisville, Kentucky.

#### STREPTELASMA INFLATUM.

*Plate 15, Figs. 17, 18.*

*Streptelasma inflatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 18. August, 1882.

Corallum simple, turbinate, straight or slightly curved, very attenuate below; exterior with gentle undulations and with strong longitudinal striæ; height forty millimeters; for about one-half the height gradually, then very abruptly expanding; diameter of calyx forty millimeters, depth twenty-five millimeters; fossette deep, commencing at the center, five millimeters in width, seven millimeters in length, situated on the posterior side; number of lamellæ eighty, alternating in size, rounded at the margin, becoming sharp on the sides. The adjacent principal lamellæ of the anterior portion of the calyx coalesce as they approach the center, these again coalesce, forming fascicles of from two to seven lamellæ; those of the anterior portion are not fasciculated.

This species bears some resemblance to the figure of *Zaphrentis corticata*, but the lamellæ are coarser; their arrangement at the center is different, and the external characters are very dissimilar to those of that species.

*Formation and Locality.* Corniferous limestone, Falls of the Ohio.

#### STREPTELASMA PAPILLATUM.

*Plate 15, Fig. 20.*

*Streptelasma papillatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History. Advance sheets, p. 21. August, 1882.

Corallum simple, turbinate, curved; exterior with gentle un-

dulations and a few sharp annulations; height of corallum fifty millimeters; diameter of calyx thirty-five millimeters; depth twenty-five millimeters; sides abruptly descending, leaving a flat or concave space at the bottom, fifteen millimeters in diameter, in the center of which is a conical elevation of five millimeters in height; number of lamellæ eighty, at the margin of nearly uniform size, alternating below, the principal lamellæ extending to the center, twisted and elevated, forming a very much contorted false columella.

This species most closely resembles *S. mammiferum*, but is less abruptly expanded. The calyx is circular, not oblique; the lamellæ are smaller, there being eight or nine in the space occupied by six in that species; the elevation on the bottom of the calyx is less prominent and somewhat different in character.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### STREPTELASMA SIMPLEX.

*Plate 16, Fig. 1.*

*Streptelasma simplex*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 18. August, 1882.

Corallum simple, turbinate, straight or slightly curved; exterior with concentric wrinkles and striæ; longitudinal striæ distinct; height of corallum thirty millimeters; depth of calyx twenty millimeters; sides regularly sloping; fossette situated a little on one side of the center, and consisting of a deep depression not extending on the sides of the calyx; number of lamellæ sixty; at the margin broad, rounded, nearly uniform in size, alternating below; the principal lamellæ extending to the center are twisted and elevated, forming a small false columella. In all the individuals observed there are no tabulæ.

One specimen having a height of nearly forty millimeters, and a diameter at the calyx of thirty-five millimeters, corresponds essentially with this species, except that on one side of the calyx is a smooth elevation extending from the center to the margin, acute at the center and expanding as it recedes, being at the margin three millimeters wide, but this feature is probably due to accident.

*Formation and Locality.*—Corniferous limestone; Falls of the Ohio.

## STREPTELASMA MAMMIFERUM.

Plate 16, Figs. 2, 3, and Plate 21, Figs. 1, 2.

*Streptelasma mammiferum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 21. August, 1882.

Corallum simple, turbinate, attenuate below, expanded on the anterior, flattened on the posterior side; exterior with annulations and gentle undulations; longitudinal striæ coarse, distinct; height sixty millimeters; calyx oval, length forty-five millimeters; width thirty millimeters; sides abruptly sloping, a conical elevation at the bottom ten millimeters in height; number of lamellæ seventy, alternating in size (in some individuals this feature is much more strongly marked than in others); near the margin the lamellæ are broad, rounded, becoming very thin as they approach the center, where they are twisted and coalescing, forming a prominent false columella, with prolonged tip.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

## STREPTELASMA TENUE.

*Streptelasma tenue*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 17. August, 1882.

Corallum small, turbinate or sub-cylindrical, regularly curved or tortuous; surface with numerous annulations; longitudinal striæ very distinct; height about thirty-five millimeters; diameter of calyx from ten to fifteen millimeters; depth from fifteen to twenty millimeters; number of lamellæ fifty, alternating in size, the larger ones extending nearly or quite to the center.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

PTYCHOPHYLLUM, *Edwards & Haime.*

## PTYCHOPHYLLUM KNAPPI.

Plate 18, Figs. 14, 15, and Plate 25, Figs. 6, 7.

*Ptychophyllum versiforme*, in part HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 22. August, 1882.

Corallum simple, turbinate, curved, sometimes tortuous, rapidly expanding; frequently intermittent and proliferous in its mode of growth; length usually from forty to sixty millimeters;

calyx from forty to seventy millimeters in diameter; exterior with frequent sharp annulations and concentric striæ; the calyx for some distance from the margin is flat, then abruptly descending, having a depth of from fifteen to twenty millimeters; center of calyx elevated; number of lamellæ from 90 to 100, slightly alternating in size, near the margin broad and nearly flat, becoming sharper as they approach the center; the stronger lamellæ continue to the center, are twisted and elevated, forming a false columella.

*Formation and Locality.*—Crab Orchard, Kentucky.

### AULACOPHYLLUM, *Edwards & Haime.*

#### AULACOPHYLLUM TRISULCATUM.

*Plate 16, Fig. 5.*

*Aulacophyllum trisulcatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 25. August, 1882.

Corallum turbinate, irregularly expanding, exterior with numerous constrictions caused by intermittent growth; internal costæ sharp, prominent; height of corallum forty millimeters; calyx thirty-five millimeters in diameter, sub-quadrangular in outline; depth twenty millimeters, sides abruptly sloping to the center. There are three fossettes, one wide and deep, extending from the center of the calyx to the anterior margin; the others not so strong, but conspicuous, are situated at right angles to the principal one; lamellæ about 112, alternate ones much larger than the others, very sharp and prominent, converging to the fossettes, and on the posterior side to a line in continuation of the principal fossette; a few lamellæ reach the center of the calyx.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio, and Clark county, Indiana.

#### AULACOPHYLLUM SULCATUM.

*Plate 17, Figs. 7-10.*

*Caninia sulcata*, D'ORBIGNY. Prodr. de Palæont. Univ., xi, p. 105. 1850.

*Aulacophyllum sulcatum*, EDWARDS & HAIME. *Polypiers Fossiles des Terrains Palæozoïque*, p. 355. Plate 6, fig. 2.

Corallum simple, turbinate, regularly curved; calyx oblique;



in some examples the length on the anterior side is 120 millimeters or more, but usually the specimens are smaller, the length of the anterior side being seventy millimeters, and the posterior side twenty-five millimeters; calyx oval or sub-rhomboidal; length fifty millimeters, width forty millimeters; in none of the numerous specimens observed is the calyx perfect, and its depth can not be exactly known, but it was probably shallow; the specimens are usually decorticated and somewhat smooth; internal costæ very prominent, converging to a line along the middle of the anterior side, and less distinctly to a line on the posterior side; the costæ of the posterior side also converge to the dextral and sinistral sides; fossette commencing near the center and continuing to the anterior margin; an obscure fossette extends from the center to the posterior margin; number of lamellæ 160, alternating in size, the smaller ones extend a very short distance from the margin; part of the anterior lamellæ converge to the fossette, the others converge to two lamellæ at right angles to the principal fossette, the greater portion of the lamellæ of the posterior side also converge to these two lamellæ, a few converge to the indistinct posterior fossette; the convergence of the lamellæ on the dextral and sinistral sides gives the appearance of lateral fossettes. The two lamellæ to which the others converge frequently coalesce and extend entirely across the calyx.

*Formation and Locality.* Corniferous limestone, falls of the Ohio, and Clark county, Indiana.

#### AULACOPHYLLUM PRÆCIPTUM.

*Plate 16, Figs. 6, 7.*

*Aulacophyllum præcipitum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 24. August, 1882.

Corallum simple, turbinate, straight or slightly curved; exterior with strong annulations, concentric wrinkles and fine striæ; longitudinal striæ fine, distinct; height of corallum fifty millimeters; diameter of calyx forty millimeters; depth thirty millimeters; sides regularly sloping to the center, the calyx having the form of an inverted cone; principal fossette narrow, extending from the center nearly to the margin; number of lamellæ 120, of nearly uniform size at the margin, alternating

below. There are two rudimentary fossettes at right angles to the principal one; the lamellæ of the anterior side converge to the principal fossette, a few converge to the rudimentary fossettes, the remaining larger lamellæ continue to the center of the calyx.

*Formation and Localities.*—Corniferous limestone; Falls of the Ohio and Clark county, Indiana.

#### AULACOPHYLLUM PRINCEPS.

*Plate 16, Figs. 8, 9, 10.*

*Aulacophyllum princeps*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 23. August, 1882.

Corallum simple, turbinate, regularly curved; exterior with numerous irregular undulations of growth, concentric wrinkles and striations; longitudinal striæ fine and very distinct; height of full-grown specimens from seventy to one hundred millimeters; diameter of calyx from forty to fifty millimeters; depth thirty millimeters; form sometimes oval or sub-quadrangular; sides abruptly descending, leaving a broad flat or elevated space at the bottom; fossette commencing anteriorly to the center, not continuing to the margin; number of lamellæ from 160 to 180, of nearly uniform size at the margin; on the sides the alternate lamellæ are much larger than the others; about two-thirds of the lamellæ converge to the fossette, or to a line in continuation of it; the remainder converge toward the center of the calyx; near the center the lamellæ are thickened and twisted. From *A. sulcatum* this species is easily distinguished by the more numerous and thinner lamellæ.

*Formation and Localities.*—Corniferous limestone, New York, and Falls of the Ohio.

#### AULACOPHYLLUM CONVERGENS.

*Plate 17, Figs. 1, 2.*

*Aulacophyllum convergens*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 22. August, 1882.

Corallum simple, broadly sub-turbinate, regularly curved; exterior comparatively smooth with concentric wrinkles and striations; longitudinal striæ fine, distinct; specimens of the same height have a diameter at the calyx varying from twenty-

five to forty-five millimeters; in one example the height is ten millimeters; length of posterior side, twelve millimeters; of anterior side, twenty-five millimeters; diameter of calyx, twenty millimeters, for a distance of five millimeters, from the margin nearly flat, then the posterior portion is nearly vertical, the anterior portion concave; fossette narrow, deep, extending from the bottom of the calyx to the anterior margin; lamellæ varying from 80 to 120 in number according to the diameter of the calyx, alternating in size, thin, denticulated; convergence of the lamellæ to the fossette very distinct.

*Formation and Localities.* Corniferous limestone, Falls of the Ohio, and Clark county, Indiana.

#### AULACOPHYLLUM PRATERIFORME.

*Plate 17, Figs. 3, 4.*

*Aulacophyllum prateriforme*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 23. August, 1882.

Corallum simple, turbinate, curved; exterior with concentric wrinkles and striations and occasional constrictions; height of corallum thirty millimeters; length of anterior side fifty millimeters; length of posterior side thirty-five millimeters; diameter of calyx forty-five millimeters; depth twenty millimeters; regularly concave, bottom of the calyx a little posterior to the center; fossette narrow extending from the center to the anterior margin; number of lamellæ 110, alternating in size; about sixteen of the larger lamellæ converge to the fossette, the others continue to the bottom of the calyx, where they are slightly twisted, not elevated.

In general appearance this species is similar to *A. convergens*, but the anterior and posterior sides are more nearly equal in length, the deepest part of the calyx is nearly central, while in that species it is posterior; the converging of the lamellæ to the fossettes is much less distinct.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

## AULACOPHYLLUM CRUCIFORME.

Plate 17, Figs. 5, 6.

*Aulacophyllum cruciforme*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 24. August, 1882.

Corallum simple, turbinate, regularly curved; length of posterior side twenty-five millimeters; length of anterior side sixty millimeters; calyx oblique, slightly oval; length forty millimeters; width thirty-five millimeters, regularly concave; fossette commencing just anterior to the center, and for the space of ten millimeters very deep and pyriform, narrowing and continuing to the anterior margin; number of lamellæ 140; nearly uniform in size at the margin, alternating below; the larger lamellæ, except those which converge to the fossette, continue to within eight millimeters of the center of the calyx, leaving a convex space sixteen millimeters in diameter, nearly smooth; at the junction of the posterior and anterior lamellæ are two rudimentary fossettes at right angles to the principal fossette.

This species is distinguished from *A. princeps* by the conspicuous pyriform fossette, the smooth space at the bottom of the calyx, and the more conspicuous lateral fossettes.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

## AULACOPHYLLUM POCULUM.

Plate 18, Figs. 2, 3, 4.

*Aulacophyllum poculum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 25 August, 1882.

Corallum simple, sub-cylindrical, short; the attached portion of the base large, frequently equal to the diameter of the corallum; height of the corallum twenty millimeters; diameter of calyx twenty millimeters; depth from eight to twelve millimeters; sides sloping abruptly, leaving at the bottom a concave space three millimeters wide; fossette situated posteriorly, extending from the concave space at the bottom of the calyx to the margin; number of lamellæ from eighty to ninety, alternating in size, the smaller ones scarcely more than rudimentary.

The lamellæ near the fossette converge to it, the others converge to the center; a few extend upon the concave tabulæ and coalesce with it.

*Formation and Locality.* Corniferous limestone, Falls of the Ohio.

#### AULACOPHYLLUM REFLEXUM.

*Plate 18, Figs. 5, 6, 7.*

*Aulacophyllum reflexum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 24. August, 1882.

Corallum simple, elongate, turbinate; exterior comparatively smooth; height forty millimeters; diameter of the calyx from twenty to twenty-five millimeters; depth fifteen millimeters; sides nearly vertical; fossette conspicuous, extending from the center to the margin; number of lamellæ eighty, alternating in size, the smaller ones about one-third the thickness of the others, and extending but a short distance from the margin, a portion of the larger lamellæ converge to the fossette, and their extremities on the side of the fossette are turned backward; the lamellæ opposite the fossette extend beyond the center to the bottom of the fossette; the remaining lamellæ do not reach the center of the calyx, their extremities forming a line at right angles to the fossette. There are two rudimentary fossettes.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### AULACOPHYLLUM PINNATUM.

*Plate 18, Fig. 1, and Plate 22, Fig. 10.*

*Aulacophyllum pinnatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 23. August, 1882.

Corallum simple, turbinate, exterior with undulations of growth; longitudinal striations distinct; height thirty-five millimeters; diameter of calyx thirty millimeters; depth twenty-five millimeters; sides regularly sloping; a narrow deep fossette extends from the bottom to the anterior margin; number of lamellæ from eighty to ninety, alternating in size, the larger ones only reaching the fossette and the bottom of cup, thickened and subangular near the margin, becoming

thinner on the sides; convergence of the lamellæ to the fössette very distinct; there are two rudimentary lateral fössettes, and a less conspicuous one on the posterior side.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### AULACOPHYLLUM TRIPINNATUM.

*Plate 22, Figs. 8, 9.*

*Aulacophyllum tripinnatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 25. August, 1882.

Corallum simple, turbinate, short, some individuals expanding gradually and others rapidly; diameter of calyx twenty millimeters; number of lamellæ eighty, alternate ones much the larger; their arrangement is as follows: On the posterior side one lamellæ extends from the margin to the bottom of the cup, a little on one side of the center; those adjacent on the left converge to it, those on the right are parallel with it; on the right side is a deep fössette, on the left side is a less conspicuous fössette, a sharp depression connecting the two; the lamellæ converge to the fössettes and the connecting depression, not reaching the center of the calyx; anterior to the depression is an oblique space ten millimeters wide, and about the same height, essentially smooth, formed by the coalescing of the lamellæ.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS, *Rafinesque.*

##### ZAPHRENTIS TORTA.

*Plate 22, Fig. 1.*

*Zaphrentis torta*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 30. August, 1882.

Corallum simple, elongate turbinate, straight or slightly curved; exterior with concentric wrinkles and striæ, and occasional sharp annulations, longitudinal striæ distinct; height of corallum sixty millimeters; diameter of calyx thirty millimeters; depth twenty-five millimeters; sides abrupt. The tabulæ, for a space of five millimeters are nearly flat, then elevated

about five millimeters for a short distance, and then curving downwards; number of lamellæ seventy-five, alternating in size, the smaller ones about one-half the thickness of the others; the principal lamellæ extend to the center of the tabulæ, fasciculating and very much twisted; the sides of the lamellæ have moderately strong longitudinal striations; fossette extending from the center of the calyx to the margin; its position variable.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio, and Clark county, Indiana.

#### ZAPHRENTIS SUBCOMPRESSA.

*Plate 18, Figs. 8, 9.*

*Zaphrentis subcompressa*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 28. August, 1882.

Corallum simple, turbinate, curved, somewhat flattened, exterior with numerous sharp annulations of growth; height of corallum, forty millimeters; calyx thirty millimeters in diameter, broadly oval; depth fifteen millimeters; sides abruptly descending; a slightly convex area at the bottom fifteen millimeters in diameter; fossette commencing near the center and extending about half way to the anterior margin; lamellæ about sixty; nearly uniform in size at the margin; thickened and subangular on the sides, becoming thinner and alternating; the principal lamellæ extend to within four millimeters of the center, becoming much thickened for the last three millimeters; the central portion of the calyx consists of a smooth, flat space eight millimeters in diameter.

This species somewhat resembles *Z. corrugata*, but the lamellæ are much thicker at the margin of the cup, and more nearly uniform in size; the central portion of the calyx is smooth, and the lamellæ are much thickened as they approach this area.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS FOLIATA.

*Plate 18, Figs. 10, 11.*

*Zaphrentis foliata*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 34. August, 1882.

Corallum simple, elongate, turbinate, curved; surface with fre-

quent narrow undulations and occasional constrictions; external striations distinct; height of corallum seventy millimeters; diameter of calyx, twenty-five millimeters, depth, twenty millimeters; lamellæ about seventy, nearly uniform in size and thickened at the margin, alternating and thin below; the principal lamellæ fasciculate and extend to within a short distance of the center, leaving a smooth concave space three millimeters in diameter.

In a transverse section the corallum appears as if composed of numerous thin invaginated laminæ; in that respect it resembles *Cyathophyllum exfoliatum*, but that species is much stronger and coarser in appearance.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS PROFUNDA.

*Plate 19, Fig. 1.*

*Zaphrentis profunda*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 31. August, 1882.

Corallum simple, elongate turbinate, curved; exterior with numerous annulations; external striæ fine, distinct; height of corallum seventy millimeters; diameter of calyx twenty-five to thirty-five millimeters; depth twenty-five to forty millimeters; there is usually a flat space at the bottom of the calyx from one-half to three-fourths the diameter of the corallum at that point, but this feature is sometimes obsolete; number of lamellæ from one hundred to one hundred and ten, alternating in size, thickened at the margin, thin and sharp below; the principal lamellæ extend to within five millimeters of the center, coalescing with the tabulæ, and leaving a smooth, nearly flat space of ten millimeters in diameter. The proportion of length and diameter is variable; individuals with calices of the same diameter vary in length from 35 to 80 millimeters.

*Formation and Locality.*—Corniferous limestone; falls of the Ohio.

#### ZAPHRENTIS ELEGANS.

*Plate 19, Figs. 2-5.*

*Zaphrentis elegans*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 37. August, 1882.



Corallum simple, turbinate, usually slightly compressed, acute at the base, regularly expanding to the calyx; exterior with concentric wrinkles and undulations, external striæ distinct, fourteen in the space of ten millimeters; when decorticated the internal striæ are usually broad, equal to one-half the number of the lamellæ; corallum usually about seventy millimeters in height; diameter of calyx thirty millimeters; depth twenty millimeters, sides abrupt, an oval space at the bottom smooth or with the lamellæ faintly indicated; fossette usually dextral, consisting of a deep elongate depression at the bottom of the cup, but faintly indicated on the sides; number of lamellæ from eighty to ninety, alternating in size, thickened and sub-angular at the margin, becoming very thin and fragile below.

This species may be distinguished from *Z. profunda* by its compressed form, shallower calyx and finer lamellæ; from *Z. nitida* it differs in its compressed form, narrower flattened space at the bottom of the calyx, and somewhat finer lamellæ.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS PONDEROSA.

*Plate 19, Fig. 7.*

*Zaphrentis ponderosa*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History. Advance sheets, p. 27. August, 1882.

Corallum simple, turbinate, curved and oblique; exterior with strong rounded ridges, longitudinal striations obscure; height of corallum, one hundred millimeters; diameter of calyx, forty-five millimeters; depth thirty-five millimeters, with a rounded elevation of fifteen millimeters in diameter at the bottom; number of lamellæ ninety, nearly uniform in size, thickened and rounded at the margin, alternating below, and becoming thin and sharp as they approach the center. A portion of the lamellæ extend to the center, twisting and coalescing with the elevated portion of the tabulæ.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS NITIDA.

*Plate 19, Figs. 6, and Plate 20, Figs. 4-6.*

*Zaphrentis nitida*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 31. August, 1882.

Corallum simple, elongate-turbinate, straight or slightly

curved; exterior with numerous sharp annulations and constrictions caused by intermittent growth; external striæ, very distinct; height of corallum eighty millimeters; diameter of calyx thirty-five millimeters; depth twenty millimeters; somewhat campanulate; a space at the bottom from ten to fifteen millimeters in diameter smooth, nearly flat; fossette consisting of a deep pit, its continuation extending on the side, but becoming obsolete before reaching the margin of the calyx; number of lamellæ, from seventy-five to ninety; nearly uniform in size; thickened and rounded at the margin, becoming thin and alternating below; the principal lamellæ extend a short distance on the tabulæ, coalescing with them, not twisted.

This species most nearly resembles *Z. profunda*, but is a more solid form, and the calyx is not so deep.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS, SPISSA.

*Plate 19, Figs. 8, 9.*

*Zaphrentis Spissa*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 30. August, 1882.

Corallum simple, abruptly turbinate, straight or slightly curved; height of corallum seventy millimeters; diameter of calyx fifty millimeters; sides regularly concave; number of lamellæ 110, of uniform thickness, alternating in length, the principal ones extending to the center, fasciculating, coalescing and twisting; presenting a very irregular appearance; fossette conspicuous, commencing a short distance from the center and extending to the anterior margin.

*Formation and Locality.*—Corniferous limestone. Falls of the Ohio.

#### ZAPHRENTIS TRISUTURA.

*Plate 20, Figs. 1-3.*

*Zaphrentis trisutura*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 30. August, 1882.

Corallum simple, turbinate, quadrilateral, straight or slightly curved; longitudinal striæ conspicuous; height fifty millimeters; diameter of calyx thirty-five millimeters; sides nearly vertical or slightly convex space at the bottom twenty-five

millimeters in diameter; fossette consisting of a deep depression at the sinistral margin of the tabulæ; number of lamellæ seventy, alternating in size, very thin and sharp on the sides of the cup, adjacent lamellæ coalescing and fasciculating, the lamellæ thus formed again fasciculate and extend to the center, where they are twisted and elevated into a comparatively sharp crest.

The quadrilateral form, convex tabulæ, deep fossette, and fasciculated lamellæ are characteristics by which this species may be easily distinguished.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS DEFORMIS.

*Plate 20, Figs. 9, 10.*

*Zaphrentis deformis*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History.

Corallum simple, sub-cylindrical, small, the attached portion broad, expanding only on one side of the apex, giving to the corallum a very oblique growth; diameter essentially uniform throughout the whole length; exterior with numerous oblique wrinkles and annulations; longitudinal striations somewhat obscure; when decorticated, the internal striæ are broad and smooth, seven in the space of ten millimeters; height of corallum thirty-five millimeters; diameter of calyx fifteen millimeters; number of lamellæ twenty-five to thirty, uniform in size, extending nearly to the center, leaving a smooth flat space five millimeters in diameter.

The great expansion on one side of the apex, the very oblique annulations, and few lamellæ, are characteristics by which this species is easily distinguished.

*Formation and Locality.*—Corniferous limestone, Charlestown, Indiana.

#### ZAPHRENTIS CYATHIFORMIS.

*Plate 15, Fig. 19. Plate 16, Fig. 4.*

*Zaphrentis cyathiformis*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 27. August, 1882.

Corallum simple, turbinate, straight or curved, exterior with gentle undulations, comparatively smooth; longitudinal stria-

tions distinct; height of corallum fifty millimeters; base attenuate; diameter of calyx twenty-five millimeters; depth twenty millimeters, sides abruptly descending, a flat area at the bottom fifteen millimeters in diameter, fossette extending from the flat space to the sinistral margin; number of lamellæ, eighty, alternating in size, thickened near the margin, becoming sharp on the sides.

*Formation and Locality.* Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS CONCAVA.

*Plate 21, Fig. 6.*

*Zaphrentis concava*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 35. August, 1882.

Corallum simple, turbinate, regularly curved; height twenty-five millimeters; diameter of calyx twenty millimeters; depth ten millimeters; the sides descend abruptly to within four millimeters of the center, where there is a narrow elevation surrounding an abrupt concavity of five millimeters in diameter; fossette narrow and deep, indenting the margin of the concave area and extending to the anterior margin of the calyx; number of lamellæ, seventy, alternating in size, a few extending to the center; tabulæ concave in the center, outer portion bending abruptly downward, intermediate portion convex.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS UNDATA.

*Plate 20, Figs. 7, 8. Plate 25, Fig. 1.*

*Zaphrentis undata*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 33. August, 1882.

Corallum simple, elongate turbinate, gradually and regularly, or abruptly curving, so that one portion is at right angles to the other; exterior with strong regular annulations and numerous moderately strong concentric striæ; tabulæ usually flat, curving downward toward the margin, and extending nearly the entire diameter of the corallum; number of lamellæ, 120, the smaller ones rudimentary. The exterior of this species so closely resembles that of *Heliophyllum annulatum*, that from the

external characters alone it would be difficult to distinguish them; internally, however, they have not the least resemblance to each other.

*Formation and Localities.*—Corniferous limestone, Falls of the Ohio, and Clark county, Indiana.

#### ZAPHRENTIS HERZERI.

*Plate 21, Figs. 7, 8, 9.*

*Zaphrentis herzeri*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 35. August, 1882.

Corallum simple, turbinate, straight or curved; the anterior side is frequently flattened in young specimens; base acute, regularly expanding to the calyx; exterior with numerous rounded annulations and concentric striæ; external striæ obscure in all the specimens observed; height sometimes forty millimeters, but usually thirty millimeters; diameter of the calyx from fifteen to twenty millimeters; depth from ten to fifteen millimeters; more or less oval; usually flattened near the margin, then abruptly sloping to the center; fossette narrow, extending from the center nearly to the anterior margin; number of lamellæ from sixty to seventy, alternating in size, the smaller ones not more than five millimeters in length; the larger lamellæ extend to the center of the cup, not twisted or elevated.

This species has been included with *Heliophyllum exiguum*, by Dr. C. Rominger, (Geological Survey of Michigan), but the form is different, and there are no traces of heliophylloid structure. It may be distinguished from *Z. ungula* by its less compressed form and the different character of the center of the calyx.

*Formation and Locality.*—Corniferous limestone, Louisville, Kentucky.

#### ZAPHRENTIS PLANIMA.

*Plate 21, Fig. 15.*

*Zaphrentis planima*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 29. August, 1882.

Corallum simple, turbinate, straight; exterior with undulations of growth; height of corallum sixty millimeters; diame-

ter of calyx thirty millimeters; depth fifteen millimeters; sides, nearly vertical; a flat and smooth area at the bottom, fifteen millimeters in diameter, the fossette consisting of a deep depression at the anterior margin of this area; number of lamellæ from eighty-five to ninety, of nearly uniform thickness, alternating in length; the principal ones faintly indicated on the outer portion of the flat area, sometimes continuing to the center. In one specimen the bottom of the cup is marked by a ridge continued from the fossette.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS DUPLICATA.

Plate 21, Fig. 3.

*Zaphrentis duplicata*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 32. August, 1882.

Corallum simple, turbinate, attenuate below, straight or slightly curved; exterior with low rounded ridges of growth; external striæ fine, distinct; height of corallum forty-five millimeters; diameter of calyx thirty millimeters; depth fifteen millimeters; sides nearly vertical, a flat area at the bottom twenty millimeters in diameter; fossette deep and narrow, commencing near the center and extending to the anterior margin; number of lamellæ 110, thickened and rounded near the margin of the cup, extending a short distance on the flattened area at the bottom; the alternate lamellæ coalesce with the others, the lamellæ thus formed fasciculate and coalesce, continuing to the center, where they appear as low tortuous ridges; the tabulæ at the center are elevated, the outer portion bending downward. This species can be distinguished from *Z. frequentata* by its finer lamellæ which are thickened and coalescing at the center, and by the narrow fossette.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS CALCARIFORMIS.

Plate 21, Fig. 10, 11.

*Zaphrentis calcariformis*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 33. August, 1882.

Corallum simple, narrowly turbinate, regularly curved; di-

diameter of calices in individuals of the same height, varying from ten to fifteen millimeters; height twenty-five millimeters; exterior with frequent undulations and low, rounded annulations; fossette narrow, very deep, commencing at the center and continuing to the posterior margin; the lamellæ extend to the margin; coalescing and forming vertical walls; number of lamellæ fifty, alternating in size; at a distance of two millimeters from the margin the smaller lamellæ coalesce with the others.

This species is easily distinguished by the deep, narrow fossette situate on the posterior side, and the regular coalescing of the lamellæ near the margin.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS OVALIS.

*Plate 23, Fig. 1.*

*Zaphrentis ovalis*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 29. August, 1882.

Corallum simple, turbinate, straight or curved, slightly compressed; exterior with numerous constrictions caused by intermittent growth; height fifty millimeters; diameter of calyx, twenty-five millimeters; depth ten millimeters; sides nearly vertical, a flat area at the bottom fifteen millimeters in diameter; fossette consisting of a deep depression at the dextral margin of the flattened area; number of lamellæ seventy-five, uniform in size, extending a short distance upon the tabulæ, and coalescing with them, becoming obsolete, and leaving a smooth area thirteen millimeters in diameter.

Though not observed in the individuals examined, it may prove that, at the margin of the cup, when entire, there are small rudimentary lamellæ, in which case the number given above would be increased.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS CONVOLUTA.

*Plate 22, Fig. 2.*

*Zaphrentis convoluta*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 37. August, 1882.

Corallum simple, turbinate, straight or regularly curved,

acute at the base, regularly expanding to the calyx, slightly compressed, oblique; decorticated specimens appearing somewhat smooth; internal striæ not prominent; height of corallum seventy millimeters; diameter of calyx forty millimeters; depth twenty-five millimeters; a central area, twelve millimeters in diameter, flat and smooth; number of lamellæ 100, alternating in size, the smaller ones about fifteen millimeters long; usually from two to four adjacent principal lamellæ coalesce and fasciculate, becoming twisted and extending to within six millimeters of the center; fossette obscure or obsolete.

This species may be recognized by the conspicuous coalescing and fasciculating of the lamellæ, and their decidedly twisted appearance after coalescing.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS COMPRESSA.

*Plate 21, Figs. 4, 5. Plate 22, Fig. 5.*

*Zaphrentis compressa*, ROMINGER. *Fossil Corals*, 1876, page 151, plate 53.

Corallum broadly turbinate, straight or very slightly curved, flattened, acute at the base, rapidly and regularly expanding; exterior with numerous, rounded, irregular annulations; external costæ, in well preserved specimens, prominent. Height of corallum one hundred millimeters; calyx oval, length seventy-five millimeters; width forty millimeters; sides, nearly vertical, leaving at the bottom a concave area about forty-five millimeters in length, and twenty millimeters in width; fossette, dextral, consisting of a deep oval pit or depression a little to the right of the center, and continuing to the margin of the concavity at the bottom of the calyx. A broad groove extends from the fossette to the sinistral margin at the bottom; on the sides of the calyx the fossette is obsolete; number of lamellæ 190, broadly angular at the margin of the calyx, and nearly equal in size, alternating on the sides; the smaller lamellæ extend to the flattened space at the bottom; the principal lamellæ extend to the fossette and continuing groove, slightly twisted.

This species closely resembles *Z. ungula* in general appear-



ance, but is much larger, the fossette is always dextral and obsolete on the sides, while in *Z. unguia* it is anterior and continues from the center to the margin.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### ZAPHRENTIS UNGULA.

*Plate 23, Figs. 2, 3, 4.*

*Zaphrentis unguia*, ROMINGER. Fossil Corals, 1876, page 151, plate 53.

Corallum broadly turbinate, flattened, acute at the base, regularly and rapidly expanding; exterior with sharp constrictions; external costæ obscure; corallum slightly and regularly curved; posterior portion regularly rounded, anterior nearly flat; height thirty millimeters; calyx, thirty millimeters in length; width, twenty millimeters; flat or gently sloping for three or four millimeters from the margin, then regularly and abruptly descending, leaving at the bottom a small flattened area, along the middle of which is a groove at right angles to the fossette, which commences at the center and continues to the anterior margin; on the flattened area at the bottom it is much more conspicuous than on the sides, where there is usually one lamellæ along the middle of the fossette; number of lamellæ eighty, at the margin thickened and of uniform size, becoming very thin, and alternating in size below; the principal lamellæ continue to the groove along the bottom of the calyx, and are slightly twisted.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio. Indiana and Kentucky.

#### ZAPHRENTIS CONIGERA.

(See under *CLISIOPHYLLUM CONIGERUM*.)

#### ZAPHRENTIS FUSIFORMIS.

*Plate 21, Figs. 12, 13.*

*Zaphrentis fusiformis*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 29. August, 1882.

Corallum simple, turbinate, very slightly curved, a little compressed, upper portion usually constricted; exterior with slight undulations of growth; height twenty millimeters; diameter

twelve millimeters at a distance of ten millimeters from the base; diameter of calyx eight millimeters; depth five millimeters; at the bottom of the calyx a slightly concave space, three millimeters in diameter; fossette narrow, conspicuous, reaching from near the center to the anterior margin; number of lamellæ sixty, alternating in size, the smaller ones scarcely more than rudimentary, the principal lamellæ extend to the concave area at the bottom of the calyx and terminate abruptly.

This species is easily recognized by its small size, constricted calyx, and the peculiar appearance of the center.

*Formation and Locality.*—Corniferous limestone, near Louisville, Kentucky.

### CYATHOPHYLLUM, *Goldfuss.*

#### CYATHOPHYLLUM VESICULATUM.

*Plate 23, Fig. 6.*

*Cyathophyllum vesiculatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 41. August, 1882.

Corallum simple, elongate turbinate, attenuate below, curved, regularly expanding to the calyx; exterior with gentle undulations of growth; height thirty-five millimeters; diameter of calyx twenty millimeters; depth fifteen millimeters; sides regularly sloping to the center; number of lamellæ sixty, slightly alternating in size, very thin; the principal lamellæ extend to the center of the calyx, not twisted. The inter-lamellar cysts are small, but very distinct. This character gives to the corallum somewhat the appearance of a *Cystiphyllum*.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### CYATHOPHYLLUM ARCTIFOSSA.

*Plate 24, Figs. 1, 2.*

*Cyathophyllum arctifossa*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 40. August, 1882.

Corallum simple, turbinate, straight or curved; sometimes regularly expanding from a conical apex; at other times the diameter at the base is greater than at a short distance above;

exterior with concentric wrinkles and moderately prominent annulations; height of corallum eighty millimeters; calyx broadly campanulate, having a diameter of fifty millimeters and a depth of twenty-five millimeters; fossette deep, narrow, commencing about eight millimeters from the center and continuing to the anterior margin; number of lamellæ 120, nearly uniform in thickness, alternating in length; the larger ones, as they approach the bottom, fasciculate, a few continue to the center, coalescing with the tabulæ.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### CYATHOPHYLLUM DEPRESSUM.

*Plate 24, Figs. 3, 4.*

*Cyathophyllum depressum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 40. August, 1882.

Corallum simple, turbinate, straight or slightly curved, exterior with annulations and undulations of growth, and very prominent longitudinal striæ, of which there are eight in the space of ten millimeters; height of corallum, eighty millimeters, regularly expanding; diameter of calyx forty millimeters; depth of anterior side thirty-five millimeters; sides parallel with the exterior wall; a flat area at the bottom twenty millimeters in diameter, with a deep depression in the center. The fossette consists of a deep depression sinistral to the center, its continuation on the side is obscurely indicated; number of lamellæ from eighty to ninety, alternating in size, the smaller ones very thin, extending to the flattened space at the bottom of the calyx; the larger lamellæ fasciculate and extend to the center, where they are slightly twisted; the interlamellar cysts are prominent, elongate, sometimes obscuring the smaller lamellæ.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

## CYATHOPHYLLUM IMPOSITUM.

Plate 23, Fig. 7.

*Cyathophyllum impositum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 40. August, 1882.

Corallum simple, turbinate, straight or slightly curved, gradually expanding; exterior with frequent sharp constrictions caused by intermittent growth, giving the appearance of a series of invaginated calices; external striæ conspicuous; height of corallum eighty millimeters; diameter of the calyx forty millimeters; depth thirty millimeters; sides regularly sloping to the center; a narrow fossette both on the anterior and posterior sides, connected by a shallow depression; number of lamellæ from 100 to 110, alternating in size, somewhat thickened near the margin, very thin and sharp on the sides of the calyx; principal lamellæ extending to the depression at the bottom of the calyx; on the sides of the lamellæ, at right angles to the margin, are numerous rounded striæ, sometimes projecting beyond the margins and forming denticulations, but usually causing the margin to appear obscurely crenulated.

The striæ have the same direction as those of *Heliophyllum*, but they are not sufficiently distinct or continuous to place the species under that genus.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

## CLISIOPHYLLUM, Dana.

The following species possesses the internal structure of *Clisiophyllum* according to the original figure of Prof. Dana, and as recognized by Mr. James Thomson, of Edinburgh, in his late publications.

## CLISIOPHYLLUM CONIGERUM.

Plate 22, Figs. 3, 4.

*Zaphrentis conigera*, ROMINGER. Fossil corals, 1876, page 149, plate 40.

Corallum turbinate or sub-cylindrical, varying in size and proportion; some specimens have a length of three hundred millimeters, and a diameter at the calyx of forty millimeters,

not increasing for half the length; other individuals of one hundred and fifty millimeters in length have a diameter at the calyx of seventy to eighty millimeters; in some specimens the surface has sharp, narrow constrictions at regular intervals, giving a somewhat invaginated aspect; while in others there are prominent annulations at irregular distances; calyx circular, depth from fifteen to thirty millimeters, sides abruptly descending; at the bottom a conical elevation with broad base, varying in height from ten to fifteen millimeters, or more; number of lamellæ 104, in a calyx of thirty millimeters in diameter; strongly alternating in size, principal ones very thin and prominent, extending to the cone at the bottom, where they are spirally twisted and frequently fasciculating.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio, and Clark county, Indiana.

Genus ACROPHYLLUM, Thomson & Nicholson.

Messrs. Thomson and Nicholson have proposed a new genus, *Acrophyllum*, founded upon *Clisiophyllum Oneidaense*, of Billings, which is very properly separated from *Clisiophyllum* as possessing characters quite unlike the typical species of that genus.

In our specimens the tabulæ are strong and well defined, becoming gradually or abruptly elevated as they approach the center. This feature depending in some measure, apparently, upon the external form of the coral, the central portion being usually abruptly conical. There are, however, specimens where the calix is nearly flat or but slightly elevated in the center. The septa are numerous and well developed, coalescing and curving as they reach the tabulæ; forming prominent, tortuous ridges on the central elevated portion, and becoming complicated with the tabulæ to form the conspicuous central prominence, which under some conditions assumes the character of a solid central axis.

The general structure of the coral is similar to *Zaphrentis*, except for the prominent central elevation of the tabulæ.

## ACROPHYLLUM ONEIDAENSE.

Figs. 1, 2, Page 302.

*Clisiophyllum oneidaense*, BILLINGS. Canadian Journal, page 128, 1859.

" " ROMINGER. Fossil Corals, 1876.

Corallum simple, turbinate or sub-cylindrical, straight or curved. Examples are extremely variable, some being short and broadly turbinate; one has a height of sixty millimeters and a diameter at the calyx of fifty millimeters, rapidly expanding from an acute base; while another specimen has a height of more than three hundred millimeters and a diameter of only fifty millimeters, the greater part of its length not increasing in diameter; many individuals are somewhat compressed, but this may have resulted from accident; the exterior has numerous constrictions, caused by intermittent growth, and often exhibits an invaginated appearance; external costæ on well preserved specimens, prominent, twelve to fourteen in the space of ten millimeters; often (especially near the base), there are numerous small conical or spiniform nodes. The sides of the calyx are nearly vertical, leaving an area at the bottom almost equal to one-half the width of the calyx, in the center of which is a prominent elevation, varying in height from ten to fifteen millimeters, the width of the base about equal to the height; this projection is caused by the elevation of the tabulæ. The number of lamellæ in a calyx forty-five millimeters in diameter is two hundred, alternating in size, the smaller ones, being merely rudimentary, are confined to the margin of the calyx and are often obsolete. The principal lamellæ are very thin and prominent, extending nearly to the base of the central elevation, fasciculating; and the thickened lamellæ thus formed extend to the apex of the cone; fossette reaching from the base of the elevation to the margin of the calyx, being much more conspicuous on the flat area at the bottom than on the sides; position variable.

This species can always be easily recognized by the exterior alone, which has some resemblance to *Blothrophyllum decorticatam*.

The following figures illustrate the interior characters of the species as presented in two weathered specimens: Fig. 1 is a turbinate form, showing a portion of the calyx with the tabulæ, in the lateral portions gradually rising towards the center. Fig. 2 is a weathered fragment of a nearly cylindrical form, showing the abrupt and extreme elevation of the tabulæ towards the center. The axis in this case is essentially solid, owing to the compactness of the tissue formed by the tabulæ and lamellæ conjoined; to which possibly the infiltration of mineral matter may have contributed.

These figures likewise illustrate the extreme variation of external form which prevails in this species.

Fig. 1.

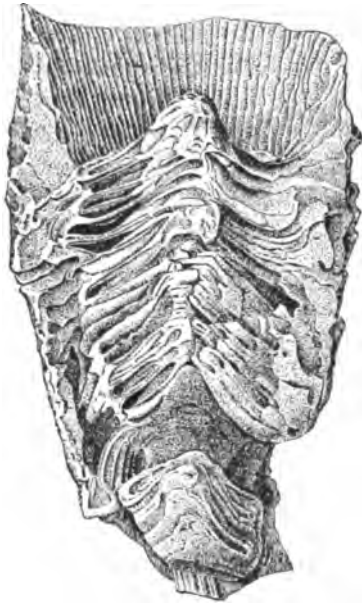


Fig. 2.



*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

DIPHYPHYLLUM, *Lonsdale*.

## DIPHYPHYLLUM APERTUM.

*Plate 27, Fig. 6, and Plate 28, Figs. 4, 5.*

*Diphyphyllum apertum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 54. August, 1882.

Corallum simple, sub-cylindrical, straight or curved, gradually or more rapidly expanding; when decorticated it presents a distinct invaginated appearance; length of one individual, sixty millimeters; calyx campanulate; diameter twenty millimeters; depth ten millimeters; number of lamellæ from sixty to seventy, of nearly uniform size at the margin, alternating below; the principal lamellæ extend to the vertical internal wall; denticulations prominent, ten in the space of five millimeters; inclosed internal area oval or horse-shoe shape, from four to six millimeters in diameter; anterior side indented by a deep, narrow fossette.

*Formation and Locality*.—Corniferous limestone, Falls of the Ohio.

## DIPHYPHYLLUM ADNATUM.

*Plate 27, Figs. 7, 8.*

*Diphyphyllum adnatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 54. August, 1882.

Corallum sub-cylindrical, simple or compound, increasing by lateral gemmation, frequently in contact for their entire length; exterior with very regular annulations and concentric striæ; longitudinal striæ distinct; diameter varying from twelve to twenty millimeters; calyx campanulate; depth about ten millimeters; number of lamellæ, fifty; uniform in thickness, alternate lamellæ continuing to the inner wall; the space inclosed by the vertical wall is three millimeters in diameter.

*Formation and Locality*.—Corniferous limestone, Falls of the Ohio.

## DIPHYPHYLLUM TUMIDULUM.

*Plate 17, Figs. 3, 4.*

*Diphyphyllum tumidulum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 55. August, 1882.

Corallum small, simple, increasing by calicular gemmation; length, fifteen millimeters, or less; diameter from three to four



millimeters for about one-half the length, then abruptly expanding; diameter of the calyx from seven to ten millimeters; depth five millimeters; number of lamellæ fifty, alternating in size; denticulations prominent; the inclosed internal area is one millimeter in diameter.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

### CYSTIPHYLLUM, *Lonsdale.*

#### CYSTIPHYLLUM LATIRADIUM.

*Plate 28, Figs. 8, 9.*

*Cystiphyllum latiradium*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 57. August, 1882.

Corallum simple, turbinate, straight or slightly curved, rapidly expanding; exterior with gentle undulations and sharp constrictions; when decorticated it presents a very distinctly invaginated appearance; height of corallum sixty millimeters; calyx broadly campanulate; diameter sixty millimeters; depth twenty millimeters; a flat space at the bottom, about ten millimeters in diameter, occupied by large cysts; near the margin are broad, gently rounded, rudimentary lamellæ of nearly uniform size, six or seven in the space of fifteen millimeters; the cysts first appear at about fifteen millimeters from the margin, becoming larger as they approach the center; the broad plications either end abruptly or are continued on the cysts as fine interrupted striæ. In a transverse section the corallum appears to be formed of thin superimposed laminæ.

In the manner of growth and appearance near the margin, this species is very similar to a *CHONOPHYLLUM*.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

### BLOTHROPHYLLUM, *Billings.*

#### BLOTHROPHYLLUM PROMISSUM.

*Plate 27, Fig. 9, and Plate 28, Figs. 6, 7.*

*Blothrophyllum promissum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 45. August, 1882.

Corallum simple, cylindrical, elongate; diameter from fifteen

to twenty-five millimeters; number of lamellæ seventy, alternating in size; at the bottom of the calyx is a flat area, either smooth or with the lamellæ but faintly indicated.

In the decorticated condition in which this species and *B. sinuosum* occur, it is not possible to separate them by external characters, but in the one species the calyx has the lamellæ extending nearly to the center, abruptly ending and the extremities twisted; the other, *B. promissum*, has a broad, smooth space at the bottom of the calyx, and the lamellæ not twisted. These characters are distinctive.

## HELIOPHYLLUM, *Hall.*

### HELIOPHYLLUM ALTERNATUM.

*Plate 24, Fig. 5, 6.*

*Heliophyllum alternatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 45. August, 1883.

Corallum simple, turbinate, usually straight; height forty-five millimeters; diameter of calyx thirty-five millimeters; depth twenty millimeters; sides nearly vertical, bottom flat; number of lamellæ, from seventy to eighty, alternating in size, the larger ones very prominent, extending nearly to the center of the cup, coalescing and forming small, irregular, central elevations; at the margin of the calyx the lamellæ are thick and rounded, growing thinner as they approach the bottom; denticulations of the lamellæ prominent, appearing as spinules, six in the space of five millimeters. This species may be distinguished by the difference in the size of the lamellæ, and the nearly vertical sides of the calyx.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

### HELIOPHYLLUM INFUNDIBULUM.

*Plate 23, Fig. 8, and Plate 24, Fig. 7.*

*Heliophyllum infundibulum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History.

Corallum turbinate, straight or curved; exterior with gentle undulations of growth and fine concentric striæ, sometimes sharply constricted by intermittent growth; diameter varying

in individuals of the same height from fifteen to twenty-five millimeters; diameter of calyx twenty-five millimeters, depth fifteen millimeters, regularly and gently concave from the margin to the center; the form of the calyx is a short, inverted cone; number of lamellæ from seventy to eighty, sometimes uniform in size, at other times alternating; the larger lamellæ continue to the center, slightly twisted; denticulations fine; no fossette.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### HELIOPHYLLUM INVAGINATUM.

*Plate 28, Fig. 1.*

*Heliophyllum invaginatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 47. August, 1882.

Corallum elongate, gradually expanding; when decorticated it has the appearance of consisting of a series of invaginated calices; height of a full grown specimen, thirteen centimeters; diameter of calyx fifty millimeters; depth thirty millimeters; when the lamellæ are perfect the calyx is somewhat campanulate, when broken away the sides of the calyx are more nearly vertical, and the bottom is flat or elevated at the center; number of lamellæ ninety; of nearly uniform size at the margin, alternating on the sides, the principal lamellæ extending to the center are flexuous or slightly twisted, very thin and prominent, from five to seven denticulations in the space of five millimeters, extending to within forty millimeters of the center of the calyx.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### HELIOPHYLLUM SCYPHULUS.

*Plate 26, Fig. 5, and Plate 28, Figs. 2, 3.*

*Heliophyllum scyphulus*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 51. August, 1882.

Corallum simple, turbinate, regularly curved; surface with frequent narrow annulations of growth and fine striations, sometimes with comparatively broad undulations. The greater portion of specimens observed are from twenty to twenty-five millimeters in height; diameter of calyx about equal to the

height; depth fifteen millimeters; a flat or slightly convex area at the bottom of the calyx when the lamellæ are perfect; fossette situated anteriorly, not extending to the margin; number of lamellæ sixty; uniform in size at the margin, alternating below, the larger ones extending to the center, slightly twisted; occasionally one or more extending from margin to margin; center of tabulæ flat, the outer portion bending abruptly downward; from three to five denticulations in the space of five millimeters, at a distance from the margin very prominent and spiniform.

This species differs from *H. Halli* in the form of the calyx, thinner lamellæ, and more distant denticulation.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### HELIOPHYLLUM TENUIMURALE.

*Plate 27, Figs. 2, 3.*

*Heliophyllum tenuimurale*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 51. August, 1882.

Corallum simple, turbinate, curved, usually decorticated, internal costæ prominent; height of corallum thirty millimeters; diameter of calyx twenty-five millimeters; depth fifteen millimeters; sides abruptly sloping, leaving at the bottom a convex area ten millimeters in diameter; fossette extending from near the center to the anterior margin of the calyx; a depression extends from the fossette across the elevation at the bottom of the calyx, connecting with a rudimentary fossette on the posterior side; number of lamellæ, ninety, alternating in size, the smaller ones rudimentary; the larger lamellæ extend to the center of the calyx, where they are elevated and twisted; seven or eight denticulations in the space of five millimeters.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### HELIOPHYLLUM ANNULATUM.

*Plate 23, Fig. 12, and Plate 25, Figs. 2, 3.*

*Heliophyllum annulatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 48. August, 1882.

Corallum simple, elongate, gradually expanding, usually compressed; exterior with prominent rounded or sub-angular an-

nulations of growth, which are sometimes at regular distances apart, also concentric wrinkles and fine striations; longitudinal striæ distinct; number of lamellæ from sixty to seventy-five; height of corallum from one hundred to one hundred and fifty millimeters, or more; often extremely attenuate, and flattened from compression. In many examples the exterior does not well exhibit the generic characters, but longitudinal sections show the heliophylloid structure.

*Formation and Locality.*—Corniferous limestone, Scott and Clark counties, Indiana, and Young's farm, Erie county, New York.

#### HELIOPHYLLUM COMPACTUM.

*Plate 25, Fig. 5.*

*Heliophyllum compactum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 48. August, 1882.

Corallum small, sub-cylindrical or elongate turbinate, straight or slightly curved, gradually expanding; exterior with broad undulations of growth, concentric wrinkles and fine striations; height of corallum fifty millimeters; diameter of calyx twenty millimeters; depth fifteen millimeters; sides nearly vertical, abruptly expanding near the margin; a flat area at the bottom of the calyx eight millimeters in diameter; number of lamellæ, seventy, nearly uniform in size at the margin of the calyx, alternating on the sides; the principal lamellæ extend on the flattened area at the bottom, abruptly coalescing with the tabulæ, leaving a smooth space five millimeters in diameter; denticulations fine, ten in the space of five millimeters; no fossette. The tabulæ are nearly flat at the middle, bending abruptly downward near their outer margins.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### HELIOPHYLLUM DISTANS.

*Plate 26, Figs. 1, 2.*

*Heliophyllum distans*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 50. August, 1882.

Corallum simple, turbinate, straight or curved; height forty-five millimeters; diameter of calyx forty-five millimeters, depth

twenty millimeters; the walls of the calyx, for a space of eight millimeters from the margin are flat, then abruptly descending; at the center an area fifteen millimeters in diameter is gently convex; number of lamellæ seventy, of uniform size at the margin, alternating below; the principal lamellæ extend nearly to the center of the calyx; denticulations thin, three in the space of five millimeters.

In general form and appearance this species is similar to *H. Halli*, but the lamellæ are much thinner, and the denticulations are at a greater distance apart, there being in that one six in an equal space occupied by three in this species.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### HELIOPHYLLUM INCRASSATUM.

*Plate 26, Figs. 3, 4.*

*Heliophyllum incrassatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 46. August, 1882.

Corallum simple, turbinate; height forty millimeters; diameter of calyx thirty millimeters; depth fifteen millimeters; sides near the margin flat or rounded, then quite abruptly descending, a flat area at the bottom ten millimeters in diameter; fossette conspicuous; number of lamellæ fifty-six, alternating in size, the smaller ones about one-third the thickness of the others; the greater portion of the lamellæ extend only to the flat space at the bottom of the calyx, from that point about fifteen are very much thickened and extend to the center, straight or slightly flexuous; denticulations moderately prominent, from six to eight in the space of five millimeters; near the margin they are wide, and become narrow and spiniform below.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### HELIOPHYLLUM FECUNDUM.

*Plate 26, Fig. 6, and Plate 27, Figs. 4, 5.*

*Heliophyllum fecundum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 49. August, 1882.

Corallum small, increasing by calicular gemmation, sometimes connected for nearly their entire length; height of a mature individual sixty-five millimeters; diameter of calyx

thirteen millimeters; for a distance of four millimeters from the margin the walls of the cup are nearly flat, then abruptly descending to a smooth area, four millimeters in diameter at the bottom; number of lamellæ, seventy, of uniform size, extending to the flat space at the bottom of the calyx; denticulations minute, no fossette. From one calyx, only twelve millimeters in diameter, proceed five buds.

This species is easily distinguished from *H. gemmatum* by its smaller size and different form of calyx.

*Formation and Locality.* Corniferous limestone, Falls of the Ohio.

#### HELIOPHYLLUM GEMMATUM.

*Plate 26, Fig. 12.*

*Heliophyllum gemmatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 49. August, 1882.

Corallum rapidly increasing in numbers by calicular gemmation; height usually from twenty-five to thirty millimeters; diameter of calyx twenty millimeters; depth ten millimeters; sides regularly sloping; a flat and smooth area at the bottom of the calyx three millimeters in diameter; number of lamellæ seventy; sometimes uniform in size, sometimes alternating, extending to the flat space at the center of the calyx; denticulations minute; sixteen in the space of five millimeters; fossette small.

In nearly all the specimens seen there are three to five buds growing from the parent corallum.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### HELIOPHYLLUM ACUMINATUM.

*Plate 26, Fig. 11.*

*Heliophyllum acuminatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 46. August, 1882.

Corallum simple, turbinate, regularly curved, length of anterior side fifty millimeters; of posterior side twenty-five millimeters; diameter of calyx forty millimeters; depth thirty millimeters; a depressed convex space at the bottom twenty-five millimeters in diameter; fossette conspicuous, extending from the convex space at the bottom to the anterior margin;

number of lamellæ eighty, alternating in size, margins broadly angular; the larger lamellæ extend upon the tabulæ, but do not reach the center; denticulations very prominent, sometimes extending nearly one millimeter beyond the margins of the lamellæ, from three to four in the space of five millimeters.

*Formation and Locality.*—Corniferous limestone, Ontario.

#### HELIOPHYLLUM SORDIDUM.

. *Plate 26, Figs. 9, 10.*

*Heliophyllum sordidum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, p. 52. August, 1882.

Corallum small, simple, turbinate, height from fifteen to twenty millimeters; diameter of calyx equal to the height. Numerous individuals of this species have been observed, but they are invariably decorticated and the margins of the calyx are broken away, so that the true form can not be accurately determined; a conspicuous fossette extends from near the center to the anterior margin; frequently along the middle of the fossette there is a prominent lamellæ; number of lamellæ from eighty to ninety, alternating in size, the larger ones thick, coalescing, fasciculating, and extending to the center, where they are twisted. Owing to the breaking away of the lamellæ near the margin, the denticulations seldom appear.

This is easily recognized as a HELIOPHYLLUM from the character of the internal costæ.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

#### HELIOPHYLLUM CORNICULUM.

*Plate 23, Fig. 9.*

*Caryophylla cornicula*, LESUEUR. 1820.

*Zaphrentis phrygia*, RAFINESQUE & CLIFFORD. 1820.

*Caninia punctata*, D'ORBIGNY. 1850.

*Cyathophyllum ammonis, delitatum and contum*, DECASTELNAU. Terr. Sil. de l'Amér. du Nord. Pl. xxi, F. 1-3.

*Zaphrentis cornicula*, EDWARDS & HAIME. Pal. Foss. des Terr. Pal., Pl. vi, F. 1.

*Cyathophyllum corniculum*, ROMINGER. Fossil corals, 1876.

Corallum simple, turbinate, regularly curved, acute at the base, rapidly expanding; exterior with shallow constrictions; the surface usually comparatively smooth; on well preserved



specimens the costæ are prominent; height usually from thirty to thirty-five millimeters, diameter from twenty to twenty-five millimeters, though examples have been found seventy millimeters in height and forty-five millimeters in diameter; one calyx of twenty-five millimeters diameter has a depth of fifteen millimeters; the sides descend regularly and abruptly, leaving at the bottom a flattened area about fifteen millimeters in diameter; fossette commencing just posterior to the center and continuing to the posterior margin, much more prominent on the bottom of the calyx than on the sides; number of lamellæ, seventy, alternating in size; the smaller lamellæ extend to the flattened area at the bottom of the calyx; the larger lamellæ continue to the center, slightly twisted; from six to eight denticulations in the space of five millimeters; near the margins of the cup they are thin and somewhat obscure, on the sides they are very prominent and spiniform. This species is very common, and found in New York and Canada, in Indiana, Ohio and other Western States. Although usually placed in the genus *Zaphrentis*, this form presents the characteristics of the genus *Heliophyllum*.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio, and various other localities.

#### HELIOPHYLLUM NETTELROTHI.

*Plate 26, Fig. 8.*

*Heliophyllum nettelrothi*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 51. August, 1882.

Corallum simple, elongate turbinate, regularly or irregularly curved. The numerous specimens observed are decorticated. The internal structure is as follows: A central area is occupied by the flat portion of the tabulæ; the tabulæ turn upward, and for a distance of ten or fifteen millimeters are nearly vertical, forming a cylindrical cavity, then turn outward and downward; in one example the flat portion of the tabulæ is eight millimeters in diameter; a space of thirty millimeters in diameter is occupied by the tabulæ and lamellæ without intermediate structure; then occur small intermediate cysts, having a direction toward the margin, and the heliophylloid rays, having

a direction toward the center. The outer area consists of a series of the projecting margins of the invaginated calices, the lamellæ of which have, on their sides and margins, prominent rays and denticulations, but no vesicles. A calyx of forty millimeters in diameter slopes abruptly to the depth of fifteen millimeters; it is then flat for a distance of eight millimeters, then turns abruptly downward and continues vertically for a distance of about thirty millimeters; transverse section (of the latter portion) usually oval; number of lamellæ from ninety to one hundred, alternating in size, the larger ones continuing to the center of the cup, though somewhat obscured on the lower portion of the vertical wall; denticulations prominent, six or seven in the space of five millimeters; on the sides of the lamellæ are oblique, coarse, rounded striations; these end abruptly at two conspicuous longitudinal grooves; from these grooves to the outer area, a space of about five millimeters, there are numerous small cysts; on the outer area there are prominent heliophylloid striæ.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

## HELIOPHYLLUM DENTICULATUM.

*Plate 26, Fig. 7.*

*Heliophyllum denticulatum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 52. August, 1882.

Corallum simple, turbinate, curved in sometimes more than one direction; exterior with numerous concentric wrinkles and fine striæ; external costæ coarse and prominent; height of corallum forty-five millimeters; diameter of calyx seventeen millimeters; depth ten millimeters, broadly campanulate; fossette commencing near the center and extending to the margin; number of lamellæ, fifty, alternating in size, principal lamellæ coalescing, fasciculating, and extending to the center.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

## HELIOPHYLLUM LATERICRESCENS.

Plate 27, Fig. 1.

*Heliophyllum latericrescens*, HALL. Thirty-fifth Annual Report of the State Museum of Natural History, advance sheets, page 49. August, 1882.

Corallum sub-cylindrical, slightly compressed, simple or compound, increasing by lateral gemmation; exterior with numerous sharp annulations of growth, concentric wrinkles and fine striæ; the largest specimen observed is ten centimeters in length, with a nearly uniform diameter of thirty millimeters; depth of calyx fifteen millimeters, somewhat campanulate, center elevated; number of lamellæ from ninety to one hundred, uniform in size near the margin of the cup, alternating below; the principal lamellæ extending to the center of the cup are twisted and elevated, forming a false columella; denticulations fine, eighteen in the space of five millimeters.

In its manner of growth, deep calyx with false columella, very fine lamellæ and denticulations, this species is easily distinguished from any others.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

## HELIOPHYLLUM ÆQUUM.

Plate 23, Figs. 10, 11.

*Heliophyllum æquum*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History, advance sheets, page 50. August, 1882.

Corallum simple, more or less curved, when decorticated having a decidedly invaginated appearance; height eighty millimeters; diameter of calyx thirty millimeters; depth twenty millimeters; the margin sub-quadrangular in outline, sides nearly vertical, a flat, smooth area at the bottom fifteen millimeters in diameter; number of lamellæ ninety, alternating in size; the larger ones are faintly indicated for a short distance on the tabulæ at the bottom of the calyx; fossette narrow and deep. This species may be known by the broad, smooth area at the bottom of the calyx.

*Formation and Locality.*—Corniferous limestone, Falls of the Ohio.

## ZAPHRENTIS COLLETTI.

Plate 18, Figs. 12, 13.

*Zaphrentis colletti*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History. Advance sheets, page 28. August, 1882.

Corallum simple, turbinate, curved, usually compressed near the base and for some distance above; calyx circular; exterior with strong, rounded ridges of growth; longitudinal striæ prominent; length of the posterior side of an adult specimen, forty millimeters; length of the anterior side, seventy millimeters; calyx forty-five millimeters in diameter; sides gradually sloping; an area at the bottom ten millimeters in diameter, very slightly elevated, smooth or rugose from the contorted lamellæ; number of lamellæ from seventy to eighty, nearly uniform in size at the margin, alternating below, the principal ones extending to the elevated area at the bottom.

In different specimens there is considerable variation in the lamellæ. Sometimes the smaller coalesce with the larger ones; lamellæ with thick, rounded margins, which continue thus to the bottom of the calyx. In other specimens they are nearly uniform at the margin, alternate ones becoming obsolete on the sides, leaving the principal lamellæ sharp. In some specimens all the lamellæ on the posterior side extend to the bottom of the calyx, giving to that side a much finer appearance than the other.

*Formation and Locality.*—Corniferous limestone, Crab Orchard, Kentucky.

## ZAPHRENTIS (AMPLEXUS?) CRUCIFORME.

Plate 22, Figs. 6, 7.

*Zaphrentis (Amplexus) cruciforme*, HALL. Thirty-fifth Annual Report of the New York State Museum of Natural History. Unpublished.

Corallum simple, elongate turbinate or sub-cylindrical, curved, very gradually increasing in diameter; exterior with irregular annulations and constrictions; longitudinal striæ very distinct. On the convex side, near the base, are several processes, which probably served for points of attachment to a foreign body. Height of corallum, forty millimeters; diameter at base, ten millimeters; calyx, fifteen millimeters in diameter, sides

nearly vertical; depth, twelve millimeters; bottom of calyx flat, smooth; number of lamellæ about fifty, alternating in size; the smaller lamellæ rudimentary and scarcely perceptible at a short distance from the margin, thus giving to the calyx a coarsely lamellate appearance.

*Formation and Locality.*—Corniferous limestone; Falls of the Ohio.

#### ZAPHRENTIS TEREBRATA.

*Plate 23, Fig. 5.*

*Zaphrentis Terebrata*, HALL. 35th An. Rep. N. Y. St. Mus. Nat. Hist. Unpublished.

Corallum, simple, turbinate, attenuate below, moderately curved; exterior with fine longitudinal striæ and a few undulations of growth; height about sixty millimeters or more; calyx subelliptical, the greatest diameter about thirty millimeters; lamellæ strong, about fifty (with an equal number of rudimentary ones), extending more than half way to the center, when they turn abruptly downward, their margins becoming laterally bent, thickened and sometimes coalescing, leaving a very narrow, deep cavity; fossette anterior, narrow, well defined, with a single ray in the bottom and one or two more toward the margin of the cup.

This species differs from *Z. ovalis*, fig. 1, of same plate, in its much smoother exterior, its coarser and more extended lamellæ, and narrow, deep calyx. From *Z. planima*, which it somewhat resembles in exterior form, it differs in the stronger, more extended and less numerous lamellæ, and much narrower calyx.

*Formation and Locality.*—In the Corniferous limestone, at the Falls of the Ohio.

#### CYATHOPHYLLUM CONCENTRICUM.

*Plate 21, Fig. 14.*

*Cyathophyllum concentricum*, HALL. 35th An. Rep. N. Y. St. Mus. Nat. Hist. Adv. sheets, p. 42, Aug. 1882.

Corallum simple, turbinate, regularly curved, solid, exterior with undulations of growth and numerous fine concentric rugose striæ; longitudinal striæ distinct; height of corallum, fifty

millimeters; calyx, thirty millimeters in diameter; depth, twenty millimeters; sides regularly concave; a space at the bottom ten millimeters in diameter, flat; fossette extending from near the center to the anterior margin; number of lamellæ, 100, nearly uniform in size at the margin of the calyx, alternating below. In some specimens the principal lamellæ extend to the margin of the flattened area below, ending abruptly, leaving the central portion smooth; in others they extend to the center, though becoming abruptly much smaller at the margin of this area. When decorticated the internal striæ are crenulated or united by septa.

*Formation and Locality.*—Corniferous limestone; Falls of the Ohio.

### COLEOPHYLLUM, *Hall.*

*Coleophyllum*, HALL. 35th An. Rep. N. Y. St. Mus. Nat. His. Unpublished.

Cyathophylloid corals, growing simply; the substance composed chiefly of a series of closely arranged, invaginated tabulæ, which are more or less oblique to the axis; rays obscure or obsolete; calices oblique.

Owing to the partial development or incomplete continuity of the tabulæ, broad shallow vesicles are sometimes formed.

### COLEOPHYLLUM, *Romingeri.*

*Plate 24, Figs. 8, 9.*

*Coleophyllum*, ROMINGERI. 35th An. Rep. N. Y. St. Mus. Nat. His. Unpublished.

Corallum simple, straight, erect. Tabulæ extremely oblique, closely arranged, scarcely united along the posterior median line; rays fine, obscure, becoming obsolete towards the middle of the shallow calyx, and converging toward the posterior fossette. Base of attachment expanded.

The specimen figured is a straight, erect form, partially silicified and decorticated. The exterior had originally fine longitudinal striæ. In its present condition the posterior side is marked by a narrow slit or fissure, which is apparently due to a deep fossette on this side, and has become conspicuous by the removal of the epitheca.

*Formation and Locality.*—Corniferous limestone; Falls of the Ohio.

## COLEOPHYLLUM PYRIFORME.

*Plate 24, Fig. 10.*

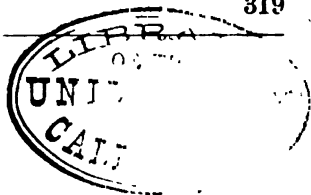
*Coleophyllum pyriforme.* Thirty-fifth Annual Report of the State Museum of Natural History. Unpublished.

Corallum obliquely turbinate, curved, regulary enlarging from the apex; calyx of moderate depth, oblique, much shallower at the posterior side; the invaginated tabulæ closely arranged, and marked by a fossette on the posterior side; rays fine, converging and fasciculating towards the fossette, the rays on the posterior side having a coarser aspect. Exterior marked by longitudinal striæ, and on the convex side by distinct annulations.

This species has a neat symmetrical form, with broad elliptical calyx. The specimens are silicified, and on that account the parts are not so clearly defined.

*Formation and Locality.*—Corniferous limestone; Falls of the Ohio.

Other species of this genus are known in the Upper Helderberg limestone, in the State of New York.



ALBANY, N. Y., February 8, 1883.

PROF. JOHN COLLETT,

*State Geologist of Indiana:*

DEAR SIR—Referring to our correspondence regarding the Spergen Hill fossils, and the preparation of a memoir upon the same, I can only repeat what I have already written. Such a memoir can not be properly completed in time for your present report, and I can only express my regret that the exigencies of your work, as you have stated to me, require some publication on the subject. I had hoped to have the much desired opportunity for such a revision of my former work as this occasion would have afforded, but any publication you may make at this time will preclude the necessity or desirability of such a memoir in the future. In the meantime I send you the following memoranda in regard to the original paper, which, perhaps, you may think it well to put upon record:

In November, 1856, I presented to the Albany Institute a paper entitled "Descriptions of New Species of Fossils, from the Carboniferous Limestones of Indiana and Illinois." This paper was prefaced by some remarks upon the subdivisions of the carboniferous limestones of the Mississippi Valley, which are now well recognized among geologists, and need not be here repeated.

The remarks and comparisons accompanying the specific descriptions of these fossils were omitted from the printed paper (except in the first two species), as the matter would otherwise have exceeded the space allotted to it in the volume. A manuscript copy of these remarks was, however, bound with my library copy of the paper, with the intention and expectation of republishing the whole in a more extended form, with illustrations of the species. Some years since, arrangements had been partially made to have this illustrated paper appear in the Transactions of the Albany Institute, but the plan was not



carried out, and in the meantime the original collection had become the property of the American Museum of Natural History, in New York city.

Sometime, about two years since, you requested me to prepare a revision of this paper, with illustrations, to be published in the Geological Report of Indiana. On application to the American Museum for a loan of the specimens for this purpose, I was informed that they were already in hand and considerably progressed for illustration in the museum publications. Thus circumstanced, it was out of my power to comply with your request, as I had in my possession but an incomplete series of specimens from Spergen Hill, and rocks of that age in other localities. The collections more recently sent to me by yourself, from the Indiana Geological Survey, have supplemented in a great degree my own collections, and have added other species, making the representation of the fauna pretty complete. This collection would have enabled me to make, as you desired, a more extended memoir upon the fossils of these strata. Your decision to publish the very excellent plates of the American Museum Bulletin, renders it superfluous to continue this work, since it would be in part a repetition of what you will publish, or, otherwise, supplemental to it.

Following the descriptions of the species, as originally published, I have appended a copy of the remarks and comparisons accompanying each one, as these were written for the original paper, and which have not before been published. Any observations of later date are inclosed in brackets.

## FORAMINIFERA..

ENDOTHYRA, *Phillips*.

## ENDOTHYRA BALEYI.

Plate 32; Figs. 34-36.

*Rotalia baleyi*, HALL. Trans. Alb. Inst., vol. iv, p. 34; 1882.

*Endothyra baleyi*, (Hall sp.) Whitfield, Bulletin 3, Am. Mus. Nat. Hist., p. 42, pl. 9, figs. 34-36; 1882.

Compare *Endothyra bowmani*, PHILLIPS.

Compare *Involutina lobata*, BRADY. See Palæontographical Soc., London, vol. xxx, p. 92, pl. 5, figs. 1-4.

Shell depressed, orbicular, sub-equally convex above and below, smooth, margin rounded, indented by the septa; spire depressed, involved; last volution slightly oblique, consisting of eight loculi; aperture contracted.

The general form of this fossil is depressed, globular, with the involutions deviating slightly from the same plane. Not unfrequently, however, the spire ascends in a greater or less degree, and one or more loculi become visible beyond the single volution. Sometimes seven loculi only are visible in the volutions. The surface is smooth under an ordinary magnifier, and the outline is indented at the septa.

This minute fossil is the first one of the Foraminifera which has fallen under our observation in the carboniferous limestone (except *Fusulina*). A single species of this genus, from the carboniferous limestone of Europe, has been described by Ehrenberg, who asserts, also, that he has evidence of the existence of foraminifera in the lower fossiliferous strata.

It gives me great pleasure to offer the slight tribute of the name of this ancient species to one who has done so much for science in our country, and of whom it would be superfluous for me to say that he stands at the head of his department;—of whose quiet, untiring zeal, patient investigation and philosophical deduction, every student of science must speak with pride and satisfaction.

*Localities*.—Alton, Ill.; Spergen Hill, Bloomington and I ville, Ind.

## ECHINODERMATA.

PENTREMITES, *Say*.

## PENTREMITES KONINCKANA.

*Plate 32, Fig. 33.**Pentremites koninckana*, HALL. Trans. Alb. Inst., vol. 4, p. 4. 1856.*Pentremites koninckana*, HALL. Geol. Iowa, p. 656, pl. 22, fig. 11. 1858.*Pentremites koninckana*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 43, pl. 9, fig. 33.

Small, globose, or sub-pyriform, upper part rounded, base sub-pyramidal, angular; basal plates small, the lateral edges short and covered by the column, allowing the base of three of the radial plates to come within the limits of the column area, the two other plates resting upon the longer sides of the larger basal plates. Radial plates short, convex in the middle and sloping to the sides, widening a little from the base upwards, and divided only half way down for the reception of the pseudo-ambulacral areas; interradial plates minute, linear or tapering very gradually upwards to a point, and having two extremely short oblique sides below: Pseudo-ambulacral areas broad, nearly plane, and extending only about half way from the summit to the base, rather deeply impressed at their rounded lower ends; poral plates varying from six to thirteen. Oral aperture small, pentagonal; anal aperture large, oval; ovarian opening small, nearly round; surface very finely and beautifully striated; striæ on the sides of the radial plates nearly vertical, but on the lower part they are deflected obliquely across so as to meet at an obtuse angle on the center below the ambulacral areas. Column at its junction with the body round, relatively very large. Length, one-twelfth to one-fourth of an inch.

This species resembles *P. caryophyllatus* of De Koninck, (*crinoides du Terrain carbonifere de la Belgique*), but differs in the shorter base and peculiarity of the basal plates, as well as in the interradial plates, which in one species are extremely small and almost linear, the one on the anal side extending into that aperture. A single individual shows a nearly entire obliteration of one of the pseudo-ambulacral spaces.

*Localities*.—Alton, Ill.; Spergen Hill, Lanesville, and Bloomington, Ind.

## PENTREMITES CONOIDEUS.

*Plate 32, Fig. 32.**Pentremites conoideus*, HALL. Trans. Alb. Inst., vol. iv, p. 5. 1856.*Pentremites conoideus*, HALL. Geol. Rept. Iowa, p. 655, pl. 22, figs. 8-10. 1858.*Pentremites conoideus*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 44, pl. 9, fig. 32. 1882.

General form conoidal or pyramidal, with the angles rounded; base sub-truncate; apex a little flattened; plates of the base somewhat flattened; radial plates extremely elongated and deeply divided for the reception of the pseudo-ambulacral areas; interradial plates deeply inserted between the radial plates, long, lanceolate, and very acutely pointed above; pseudo-ambulacral spaces very elongate, narrow, extending nearly to the base, with sides sub-parallel, convex along the median line; median line sharply depressed; poral plates varying with age from twenty-five to fifty; ovarian apertures circular; anal aperture ovate and much larger than the others. Surface marked by fine, closely arranged striæ, which on the radial plates are parallel to the margins till near the summit, where they are stronger and diverge from the suture; striæ on the interradial plates diverging from the center.

Length, from one-fourth to three-fourths of an inch.

In young specimens the base is more extended and the poral pieces much fewer than in older specimens.

Associated with this species and having a similar general aspect, I have observed a single specimen, having a length of three-fourths of an inch, of an obtusely quadrangular form and having but four pseudo-ambulacral areas, one of them being much wider than the others. There are, however, five ovarian openings at the summit. This appears to be an individual where the two adjacent sides of the radial plates have never been developed, while at the same time an effort has been made to preserve the symmetry of the ovarian openings.

*Localities.*—Spengen Hill, Lanesville, and Bloomington, Ind.

## BRACHIOPODA.

ORTHIS, *Dalman*.

## ORTHIS DUBIA.

*Plate 29, Figs. 1-5.**Orthis dubia*, HALL. Trans. Alb., Inst., vol. 4, p. 12. 1856.*Orthis dubia*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 45, pl. 6, figs. 1-5. 1882.

Shell circular or oval-ovate, valves nearly equally convex. The dorsal valve somewhat more rotund; ventral valve flattened in the middle, with a broad depression extending thence to the front of the shell, giving it a sinuous outline; beak of ventral valve extended beyond the opposite valve, slightly incurved with a triangular foramen; area very small and (with the foramen of the ventral valve) nearly covered by the beak of the dorsal valve which curves towards the opposite valve, bringing the two almost in contact at their margins. Surface marked by fine rounded, closely arranged striæ, which increase by bifurcation and implantation; the striæ down the mesial depression are distinctly tubular, with minute, pore-like openings at intervals, directed downwards. Minute pore-like openings are sometimes seen on other parts of the shell, but never so conspicuous as in the ventral sinus.

Length, .09 to .45; width, .10 to .45 of an inch,

This species is extremely like *O. michelina*, but does not attain more than one-tenth the size of the larger forms of that species. It differs likewise in the greater convexity of the dorsal valve near the lateral margins, and in having a more distinctly defined mesial depression or sinus in the ventral valve. The beaks are also more prominent, especially that of the ventral valve. It is barely possible that this may be the young of *O. michelina*. [Compare with *O. theimii* White.]

We know a species in the Helderberg which in its young state has both valves nearly equally convex with prominent beak, while in maturing it becomes flattened and the ventral valve concave with the edges elevated, while in some stages of growth there are indications of a broad shallow sinus down the center of the ventral valve.

*Localities*.—Spergen Hill, Paynter's Hill, Lanesville, and Bloomington, Indiana.

## STREPTORHYNCHUS (ORTHIS) UMBRACULUM (Schlot.)

There are several small specimens in the collection which appear to be identical with *O. umbraculum*. The specimens are scarcely more than half an inch in diameter.

*Localities*.—Spergen Hill, Lanesville, and Bloomington, Ind.

PRODUCTUS, *Sowerby*.

## PRODUCTUS BISERIATUS.

*Plate 29, Figs. 8-12.*

*Productus biseriatus*, HALL. Trans. Alb. Inst., vol. iv, p. 12. 1856.

*Productus biseriatus*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 46, pl. 6, figs. 8-12. 1882.

Shell longitudinally ovate, ventral valve extremely gibbous, without sinus, arcuate, marked by five or six elevated distant concentric undulations, which are ornamented upon their upper margins by a single row of elongate pustules or nodes, and on their middle and basal margins by numerous smaller granulations; beak attenuate and extremely arcuate; dorsal valve semi-oval, flattened near the base, having the greatest concavity near the beak, which is obtuse; surface of the dorsal valve marked by eight or nine closely-arranged concentric bands, which are marked by granulations, as in the ventral valve; hinge-line scarcely so long as the greatest width of the shell; extremities rounded.

This species is allied to *P. elegans*, of McCoy. (See Synopsis of the Carb. Fossils of Ireland, pl. 18, fig. 13, and British Pal. Foss., pl. 3, 4, fig. 4.) It has likewise some resemblance to *P. fimbriatus* (Sow. T., 459, f. 1, vol. v, de Koninck Monog. Productus, etc., p. 127, pl. 21.) It differs from the latter, however, in having the finer granulations on the lower margins of the concentric band, while *P. fimbriatus* has the larger nodes only, and these are of less proportional size than in our shell. It approaches in character the young of *P. punctatus*, but is narrower, and the beak of the ventral valve is more slender. There is no indication of a ventral sinus.

*Localities*.—Alton, Illinois; Spergen Hill, Paynter's Hill, and Bloomington, Indiana.

## PRODUCTUS INDIANENSIS.

Plate 29, Figs. 6, 7.

*Productus Indianensis*, HALL. Trans. Alb. Inst., vol. iv, p. 13. 1882.*Productus Indianensis*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 47, pl. 6, figs. 6, 7. 1882.

Shell sub-ovate, gibbous, inflated; ventral valve without sinus, gradually contracting towards the beak, which is large and strongly arcuate, obtuse at the extremity and very gibbous below; surface pustulose, or aculeate, marked by extremely fine, concentric striæ, and a few irregular undulations; pustules or bases of spines irregularly distributed over the surface of the shell, with a linear series down each side below the hinge extremity; hinge-line apparently less than the width of the shell.

This species resembles *P. subaculeatus* (Murchison, de Koninck, Monog., p. 142, pl. 16, fig. 4), but our shell is narrower, more extremely gibbous in the center, and more gradually contracting toward the beak, which, also, is more gibbous and more strongly arcuate. The bases of the spines or tubes are likewise proportionally much smaller than in *P. subaculeatus*.

*Locality*.—Spergen Hill, Indiana.

## SPIRIFERA, Sowerby.

## SPIRIFERA BIFURCATA.

Plate 29, Figs. 13, 15.

*Spirifera bifurcata*, HALL. Trans. Alb. Inst., vol. iv, p. 8. 1856.*Spirifera bifurcata*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 47, pl. 6, figs. 13-15. 1882.

Shell semi-elliptical in general form; ventral valve gibbous; dorsal valve, depressed convex; plications, seven or eight, which appear to coalesce towards the cardinal margin; mesial fold with a defined depression in the center, reaching half way to the beak; surface longitudinally striated and concentrically marked by fine lines.

Length, .09; width, .11 of an inch.

In worn specimens the longitudinal striæ are often obliterated, and the plications have the appearance of bifurcating. In general form the shell differs little from *spiriferina Norwoodana*,

but may be distinguished by the presence of longitudinal striæ and finer concentric lines, while the plications are less strong and the whole shell is less robust.

*Locality.*—Spergen Hill, Indiana. *Spiriferina* (*spirifer*) *spinosa* (Norwood and Pratten) occurs at Bloomington, Indiana, and above Alton, Illinois, in the same association with the preceding.

## SPIRIFERINA, *D'Orbigny*.

### SPIRIFERINA NORWOODANA.

*Plate 29, Figs. 16, 17.*

*Spiriferina norwoodana*, HALL. *Trans. Alb. Inst.*, vol. iv, p. 7. 1856.

*Spiriferina norwoodana*, HALL. *Whitfield*; *Bulletin 3, Am. Mus. Nat. Hist.*, p. 48, pl. 6, figs. 16, 17. 1882.

Shell small, semi-elliptical, very gibbous, angles rounded; hinge line less than the greatest width of the shell. Ventral valve very convex and strongly arching near the beak, which is curved over the area; plications about eight, the central ones very strong, and the mesial depression distinctly continued to the beak. Dorsal valve ranging from depressed convex to extremely convex, and marked by three strong plications on each side of the mesial fold, which has often a depressing line along the center towards the base, with scarcely a distinct fold in the sinus of the ventral valve. Area small, high, not extending to the extremities of the hinge; foramen scarcely higher than wide; surface, in unworn specimens, marked by concentric, imbricating lamellæ.

Length, .07 to .18; width, .08 to .21 of an inch.

This species in its more perfect condition exhibits the plications extending very distinctly to the cardinal margin. In some specimens, the depression along the mesial fold is very marked, while in others it is scarcely visible. In some young shells which are apparently of the same species, the plications do not continue so well marked to the apex, while the wearing of the surface sometimes produces an apparent coalescing of the plications towards the beak.

*Localities.*—Alton, Ill.; Spergen Hill, Ind.



ATHYRIS, *McCoy*.

## ATHYRIS HIRSUTA.

*Plate 29, Figs. 18-21.**Spirigera (Athyris) hirsuta*, HALL. Trans. Alb. Inst., vol. iv, p. 8. 1856.*Athyris hirsuta* (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 49, pl. 6, figs. 18-21. 1882.

Shell varying in form from ovate to sub-circular; beak prominent, slightly extended, front compressed, sometimes faintly sinuate. Valves nearly equally convex, the ventral valve most convex toward the beak; beak of ventral valve prominent, incurved so as to bring the minute foramen nearly on a line with the margin of the shell; beak of the smaller valve closely incurved beneath the beak of the opposite valve. Surface ornamented by concentric, imbricating lamellæ which give origin to successive rows of minute spines.

The cast shows faint impressions of radiating striæ, which are not visible on the external surface of the shell. A narrow, impressed line is sometimes shown down the center of the cast of the ventral valve; and a few specimens have a shallow, depressed groove down the center of the shell, from beak to base in both valves. A cast of a large individual shows about seven turns of the internal spire.

This shell in its young state is usually ovate, the broadest end being the front of the shell; the beaks are distinct and elevated, gradually tapering from the body of the valve. As the shell becomes older, it assumes a broader and more nearly circular form, and the beak becomes more elevated above the body of the shell than in the young state. The greater number of these shells have no trace of a sinus, but in some of the older specimens there is a slight depression in the larger valve, which produces a sinuosity in front. The minute spines appear to be produced by the splitting of the edges of the imbricating lamellæ. In some specimens the spines are very distinct near the border of the shell, but in worn individuals nothing remains but the fine, concentric lines.

From the foregoing description it will be seen that this species is closely related to the *Terebratula Roysii* of Leveille, and to *T. planosulcata* of Phillips. It differs from the first in its

small size and more ovate form, especially of young individuals, and in never having the distinct sinus possessed by that shell; while the beaks of our shell are more prominent and the slope on each side is less concave. The volutions of the internal spire in *A. hirsuta* are not more than half the number represented in *T. Roysii*. From the *T. planosulcata*, it differs in its smaller size, in being less ventricose, especially toward the front margin, in the proportionally more prominent beaks and generally more elongate form. From the specimens examined, the projecting spinose lamellæ in our shell are never so much extended as in that species. [Larger specimens of this species from Lanesville, Ind., indicate its near relation, if not identity, with *Athyris subquadrata*.]

*Localities*.—Alton, Ills.; Spergen Hill, Lanesville, and Bloomington, Ind.

#### ATHYRIS TRINUCLEUS.

*Plate 29, Figs. 22, 27.*

*Terebratula trinucleus*, HALL. Trans. Alb. Inst., vol. 4, p. 7. 1856.

*Terebratula trinucleus*, HALL. Geol. Rept. Iowa, p. 659. 1858.

*Athyris trinucleus*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 50, pl. 6, figs. 22-27. 1882.

Shell sub-pentagonal or ovate, robust; trilobate lobes nearly equal, valves nearly equal, the ventral one gibbous toward the beak; a sinus in the center, beginning above the middle of the valve, gradually becoming wider and deeper toward the base, and some specimens distinctly bounded by an obtusely angular ridge. Dorsal valve varying from sub-circular to transversely oval and longitudinally ovate, most convex between the center and the beak, and distinctly trilobate, lobes extending about half way to the beak; the middle lobe often marked by a distinct linear depression; beak of ventral valve strong, rounded and incurved; truncated vertically by a distinct rounded foramen. Surface marked by fine concentric lines, which undulate with the lobes, and are extremely sinuous near the margin of the shell.

Old shells are often marked by strong imbricating lamellæ at unequal distances.

Length, .20 to .51; width, .19 to .26 of an inch.

This is a robust species, exhibiting some variations in form, but preserving sufficiently its distinctive characteristics to be recognized in all its forms and stages of growth. The trilobate character of the lower half of the shell is less distinct in the young individuals, but is always to be discerned. The longitudinally ovate forms are less distinctly trilobate near the base than the shorter ones. The strong imbricating lamellæ of growth are often visible near the margins of the valves in young shells, and become more conspicuous with age.

[Later collections, and particularly those of the Indiana Geological survey, furnish specimens of much larger proportions than those originally described, and in many of these the internal spires are well preserved, or are exposed in broken specimens, clearly proving its relations with *Athyris*.]

*Localities*.—Spergen Hill, Lanesville, Greencastle Junction, and Bloomington, Indiana.

## RHYNCHONELLA, *Fischer*.

### RHYNCHONELLA RICINULA.

*Plate 29, Fig. 46.*

*Rhynchonella ricinula*, HALL. Trans. Alb., Inst., vol. 4, p. 9. 1856.

*Rhynchonella ricinula*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 53, pl. 6, fig. 46. 1882.

Shell very small, longitudinally ovate or sub-lenticular, neatly rounded in front; valves almost equally convex; beak of ventral valve straight, comparatively much extended, perforate by a triangular foramen; surface marked by from twelve to sixteen angular plications, which often terminate abruptly about one-third of the distance from base to beak, sometimes becoming obsolete on the upper half of the shell.

Length, .11; width, .10 of an inch.

This shell bears a close resemblance to *R. (atrypa) nana*, of McCoy (Carb. Foss. of Ireland, p. 655, pl. 22, fig. 19), but our shell is smaller, and has from two to six plications or more on each valve. In many specimens the plications are strong on the margin, and terminate abruptly on the lower third of the shell, while in others they are faintly visible on the upper half. It is possible that the presence or absence of the plications is,

in some degree, affected by wearing or maceration. With a larger number of specimens for comparison, this shell might be found identical with Professor McCoy's species.

Thus far I have not found gradations from this to larger forms, but it is still possible that this form may prove to be a young shell.

*Locality.*—Spergen Hill and Lanesville, Indiana.

### RHYNCHONELLA GROSVENORI.

*Plate 29, Figs. 31-34.*

*Rhynchonella grosvenori*, HALL. Trans. Alb. Inst., vol. iv, p. 10. 1856.

*Rhynchonella grosvenori*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 53, pl. 6, figs. 31-34. 1882.

Shell globose or sub-triangular, rotund or depressed; dorsal valve more convex than the other; greatest convexity of the two valves near the front, sloping abruptly toward the beak, where the two sides meet at nearly a right angle; beak of the ventral valve rather small, neatly defined, nearly straight or slightly incurved, with a linear or sub-triangular foramen, beak of opposite valve round and obtuse, closely incurved; surface marked by from fourteen to eighteen distinct, rounded, simple plications, which often become obsolete toward the beaks; four or five of the folds depressed, forming a sinus on the larger valve, with a corresponding elevation of five or six plications on the opposite valve.

Length, .14 to .22; width, .13 to .23 of an inch.

This species is one of a very numerous group, of which *R. Wilsoni* may be considered as the typical form, and it becomes very difficult to give such characters as will serve to distinguish it from all others of the same group. The young shells are ovate-depressed, the margins presenting no appearance of a sinus. As the shell increases in size it becomes more rotund, the sinus in the margin becomes gradually indicated, and finally the shell assumes an almost globular form, with the small triangular beak projecting above, and the plications in the sinus greatly elevated.

*Localities.*—Alton, Ill.; Spergen Hill, and Bloomington, Ind.

## RHYNCHONELLA MUTATA.

Plate 29, Figs. 43-45.

*Rhynchonella mutata*, HALL. Trans. Alb. Inst., vol. iv, p. 10. 1856.

*Rhynchonella mutata*, HALL. Geol. Rep. Iowa, p. 658, pl. 23, fig. 2. 1858.

*Rhynchonella mutata*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 52, pl. 6, figs. 43-45. 1882.

Shell sub-trigonal, more or less gibbous, front broadly rounded or nearly straight, abruptly tapering to the apex, the two sides meeting at an angle of nearly  $90^{\circ}$ ; dorsal valve much more convex than the opposite one, which is often depressed; shell most convex near the anterior margin; beak of ventral valve nearly straight, or but slightly incurved; foramen triangular; beak of the opposite valve obtusely angular and closely incurved against the ventral valve; surface marked by from twelve to sixteen strong sub-angular plications, about four or five of which are depressed in the sinus of the ventral valve; sinus not deeply impressed on the margins of the shell; concentric striæ rarely visible.

Length, .15 to .30; width, .14 to .32 of an inch.

This shell strongly resembles *R. grosvenori* in some of its varieties; but the shell is larger and more coarsely and strongly plicated, more angular in its outline, generally broader across the base, and having, in some of its varieties, the form of an equilateral triangle. Some specimens which appear to be identical with this species are very much compressed and sharp on the anterior margin, with a scarcely distinct sinus, while others are very gibbous and extremely obtuse along the front margin. In a few instances strong concentric striæ are visible, and it is probable that all the specimens were originally marked by similar fine concentric lines. It is a variable species, presenting few exclusive characters.

*Localities.*—Alton, Ills.; Spergen Hill, and Lanesville, Ind.

## RHYNCHONELLA SUBCUNEATA.

Plate 29, Figs. 47-49.

*Rhynchonella subcuneata*, HALL. Trans. Alb. Inst., vol. iv, p. 11. 1856.*Rhynchonella subcuneata*, HALL. Geol. Rept. Iowa, p. 658, pl. 23, fig. 3. 1858.*Rhynchonella subcuneata*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 51, pl. 6, figs. 47-49. 1882.

Triangular, sub-cuneate; front rounded, meeting the lateral slopes at an obtuse angle; sides sloping to the beak and meeting at an angle of  $60^{\circ}$  or  $65^{\circ}$ ; valves nearly equally convex, ventral valve most convex toward the beak; beak of ventral valve very acute, scarcely incurved, and perforate by a triangular foramen; dorsal beak of valve acute, closely incurved below the triangular foramen. Surface marked by about twelve to fourteen (and rarely sixteen) strong, simple, angular plications, which are somewhat obsolete near the beak; scarcely any indications of a sinus; plications crossed by fine concentric striæ, and in old shells, at irregular distances, by stronger imbricating folds or wrinkles parallel to the lines of growth; sides of both valves beneath the beak free from plications, and forming a very distinct elongate-oval space.

Length, .16 to .41; width, .15 to .39 of an inch.

This is a well marked species, quite distinct from either of the preceding, and distinguished by its elongate triangular form and the long oval concave space on each side below the beaks, which is limited on both valves by a distinct angular margin. In young individuals the shell is very flat, especially toward the front, but it becomes more convex and sometimes extremely gibbous with age. This species resembles *R. cuneata*, from which it is distinguished by the more numerous plications and shorter form. In the plain concave elliptical areas on each side below the beaks, it resembles the *R. (Terebratula) trilatera* of De Koninck, according to his description; while the sinus in both valves of that species, as well as other characters, are quite distinctive.

*Localities.*—Bloomington, Lanesville, and Spergen Hill, Ind.

## RHYNCHONELLA MACRA.

Plate 29, Figs. 40-42.

*Rhynchonella macra*, HALL. Trans. Alb. Inst., vol. iv, p. 11. 1856.

*Rhynchonella macra*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 52, pl. 6, figs. 40-42. 1882.

Shell triangular, flattened; apex acute; valves nearly equal; the ventral valve a little more convex towards the beak, which is quite straight, extended beyond the lesser valve, and with a sub-triangular foramen which is slightly rounded above. Surface marked by from eighteen to twenty-four small rounded plications which are about equal to the spaces between.

Length, .15 to .24; width, .14 to .29 of an inch.

This shell is always compressed and extremely thin toward the front, attaining only a moderate convexity near the beaks. The young shells bear some resemblance to the young of *R. subcuneata*, but may always be distinguished by the greater number of plications, a more compressed form, and an absence of the flattened or concave areas on each side below the beaks. The front of the shell is usually straight, but in old shells it is sometimes slightly undulating, the depression being always in the dorsal valve.

*Locality*.—Lanesville, Ind., and Alton, Ill.

CAMAROPHORIA, *King*.

## CAMAROPHORIA [?] WORTHENI.

Plate 29, Figs. 35-39.

*Rhynchonella wortheni*, HALL. Trans. Alb. Inst., vol. iv, p. 11. 1856.

*Camarophoria wortheni*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 54, pl. 6, figs. 35-39.

Shell small, longitudinally sub-trigonal, very abruptly tapering to the apex; dorsal valve very convex or gibbous towards the front; ventral valve nearly flat and broadly sinuate in front, with a single broad flattened plication, commencing near the margin, and filling a deep sinus in the opposite valve, corresponding to two short rounded plications on the front of the dorsal valve; edge of the shell on each side of the mesial sinus sharply undulated, with indistinct marginal folds. Beak of

the ventral valve pointed, straight, with a triangular foramen. Surface marked by fine concentric striæ, and some faint remains of finer radiating striæ.

Length, .26; width .24 of an inch.

This species apparently belongs to the same group as *R. acuminata*, *R. pugnus*, etc. It differs from the young plicated varieties of *R. acuminata* in the flatter ventral valve, more trigonal form, and straight beak. There are one or two other forms in the Chemung group and Carboniferous limestone not widely removed from this form. The species belongs to a group which is subject to much variation, and it is probable that we shall find other individuals differing in the number and strength of the plications.

*Locality*.—Alton, Ill.

## EUMETRIA, *Hall.*

### EUMETRIA VERNEUILIANA.

*Plate 29, Figs. 28-30.*

*Retzia verneuiliana*, HALL. Trans. Alb. Inst., vol. iv, p. 9. 1856.

*Retzia verneuiliana*, HALL. Geol. Rept. Iowa, p. 657, pl. 23, fig. 1. 1858.

*Eumetria verneuiliana*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 50, pl. 6, figs. 28-30. 1882.

Shell longitudinally ovate; valves almost equally convex, ventral valve most prominent near the beak, which is elevated and incurved so as to bring the circular foramen nearly on a line with the margins of the valves; foramen round. The dorsal valve smaller, auriculated on the cardinal angles, beak small, scarcely rising above the straight cardinal margin; area small, triangular, not entirely confined to the larger valve, bounded by a distinct angular margin. Surface longitudinally striate, marked by about fifty rounded, beautifully punctate, simple striæ.

Length, .10 to .32; width, .08 to .27 of an inch, usually; some specimens have a length of three-fourths of an inch.

This is a neat, beautiful little species, uniformly marked by simple rounded striæ, the valves nearly equally convex (except near the beak of the larger valve), without any trace of a sinus. The form is usually rotund, but sometimes flattened towards the



front. The cardinal line of the smaller (dorsal) valve is extended on each side, giving it much the appearance (when seen alone) of a small pecten. In well preserved specimens the area is very distinct and sharply defined. The punctæ are only visible under a good defining glass.

The nearest analogies are with *Retzia* (*Terebratula*) *Marcyi* [=EUMETRIA] of Shumard, (Marcy's Rept. on the Exp. of Red river of Louisiana, p. 203, pl. 1, fig. 4), and with *R.* (*terebratula*) *serpentina* [=EUMETRIA] of de Koninck (Carb. Fossils Belgium, p. 291, pl. 19, fig. 8), Woodward, Davidson, etc. It differs from the former in having a greater number of striæ and more elongate form, while the specimens are usually much smaller. Its geological position is very different, the *R. marcyi*, which occurs in the limestone of the coal measures, while the present species lies far beneath the coal. From *R. serpentina* it differs in its much smaller size and more numerous striæ which are always simple, while the beak of the larger valve is not so large and wide as represented in the figures of *R. serpentina*.

If, as stated by de Koninck, *terebratula serpentina* is not auriculate, this character in *R. verneuilliana* is sufficient to distinguish it.

There is a much larger species with stronger radii, occurring in the Kaskaska limestone, which I have seen in collections labeled *T. serpentina*.\* In that shell the radii are fewer and the smaller valve is less distinctly auriculate at the cardinal angles.

*Localities*.—Spergen Hill, Lanesville, and Bloomington, Ind.

## TEREBRATULA, *Lhwyd*.

### TEREBRATULA TURGIDA.

*Plate 29, Figs. 53-58.*

*Terebratula turgida*, HALL. Trans. Alb. Inst., vol. iv, p. 6. 1856.

*Terebratula turgida*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 54, pl. 6, figs. 53-58.

Shell longitudinally ovate, often extremely gibbous, emarginate in front; ventral valve most convex in the middle,

\* This species is the *Retzia vera* of the Iowa Geological Report—*Eumetria vera*.

having a sinus extending to the base of the shell; umbo large, rounded and prominent; beak incurved and pointed, with an oval or sub-circular foramen just above, or in the extremity; dorsal valve most convex in the middle or near the front, with or without a short sinus, in which is sometimes a short and obscure fold. Surface marked by strong concentric lines of growth, and near the front, in some shells, are strong wrinkles or folds which distort the form of the shell.

Length, .16 to .32; width, .13 to .27 of an inch.

This shell has its nearest affinities with *T. sacculus*, but differs in being much more gibbous in old shells and narrower, the depth being often greater than the width; the beak of the ventral valve is comparatively larger and more rounded. From *T. hastata* it differs equally in these respects, and still more in its much smaller size.

In young shells of this species the form is oval or ovoid, the valves moderately convex, and flattened toward the front, which may or may not present the emarginate character, both valves being sometimes without a sinus. As the shell becomes older it acquires a more gibbous form, and sometimes becomes extremely turgid, the surface being concentrically contracted and expanded at intervals by irregular growth. The sinuosities of one or both valves are often developed in the young state, producing the emarginate front, and, rarely, the fold in the sinus of the dorsal valve. Surface finely punctate.

*Localities.*—Alton, Ills.; Bloomington, Lanesville, and Spergen Hill, Ind.

#### TEREBRATULA FORMOSA.

*Plate 29, Figs. 59-64.*

*Terebratula formosa*, HALL. Trans. Alb. Inst., vol. iv, p. 6. 1856.

*Terebratula formosa*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 35, pl. 6, figs. 59-64. 1882.

Shell longitudinally oval-ovate; ventral valve more convex in the middle and upper part; beak extended upwards, prominent, incurved; valves compressed near the front, which is neatly rounded, the margin presenting a slight undulation; sometimes sinuate in front; surface marked by fine concentric lines of

growth, and sometimes by stronger parallel folds or wrinkles. Under the magnifier the shell presents a finely punctate structure.

Length, .14 to .44; width, .10 to .31 of an inch.

In the typical forms of this species the valves are symmetrically convex, sloping gradually to the front, where there is sometimes a slight undulation in the outline of the edges. In some specimens there is a depression in the ventral valve, near the lower part, producing a straightening, or even a slight emargination in front. In this respect it has some analogy with *T. hastata*, but the dorsal valve is never depressed, and the front is proportionally narrower. In the young of this species and of *T. turgida* there is a similarity in some specimens, but the older shells show a well marked distinction. This species attains a much larger size than any of our specimens of *T. turgida*.

*Localities*.—Alton, Ill.; Bloomington, Lanesville and Spergen Hill, Ind.

## LAMELLIBRANCHIATA.

### CYPRICARDELLA, *Hall*.

Shell ovate or sub-elliptical, and sub-quadrate (sub-equilateral), closed; surface concentrically striated, hinge of right valve having two cardinal teeth; the anterior tooth directly beneath the beaks, somewhat strong, triangular; posterior tooth more slender, and turned obliquely backwards, leaving a triangular pit, which is probably occupied by a tooth in the other valve; anterior cardinal margin with a long, narrow groove, apparently for the reception of a slender projection of the other valve; posterior side beveled from above, edge thin, ligament external, occupying a deep cavity; muscular impressions distinct, shallow; pallial impression simple.

In form and external characters these shells resemble the genus *MICRODON*, of Conrad, but we do not know fully the characters of the hinge of that genus. Since the interior of only a single valve has been observed, it might be premature to attempt to assign to this genus its true place.

This genus includes a small group of shells usually referred to *Cypricardia*, but, in their external and internal characters,

they are unlike, differing from *Cypricardia* in having only two cardinal teeth. Our shells have the form and external markings of *Nucula rectangulosis* of McCoy, which is referred by D'Orbigny in his *Prodrome to Cypricardia*.

It seems necessary to construct a genus of these species marked by fine, regular, concentric lines and broad posterior extremity, which is usually more or less truncate, since we know from external characters alone that they are not correctly referred to *Cypricardia*.

#### CYPRICARDELLA SUBELLIPTICA.

*Plate 30, Figs. 27-29.*

*Cypricardella subelliptica*, HALL. *Trans. Alb. Inst.*, vol. iv, p. 17. 1856.

*Microdon (Cypricardella) subelliptica*, (Hall, sp.) Whitfield; *Bulletin 3, Am. Mus. Nat. Hist.*, p. 64, pl. 7, figs. 27-29. 1882.

Shell sub-elliptical obliquely truncated at the posterior end; beaks minute at the apex, rising a little above the hinge; umbones sub-gibbous, with an undefined elevation extending obliquely toward the posterior basal margin; anterior end narrower than the posterior, rounded at the extremity. Cardinal margins forming an angle with the beak of 25°; base forming a regular elliptical curve. Surface marked by regular, fine, concentric, elevated lines which are equal to the spaces between.

Length, .19 to .32; width, .14 to .24 of an inch.

*Locality*.—Spergen Hill, Ind.

#### CYPRICARDELLA NUCLEATA.

*Plate 30, Figs. 35, 36.*

*Cypricardella nucleata*, HALL. *Trans. Alb. Inst.*, vol. iv, p. 17. 1856.

*Cypricardella nucleata*, HALL. *Geol. Rept. Iowa*, p. 664, pl. 23, fig. 10? 1858.

*Microdon (Cypricardella) nucleata* (Hall, sp.) Whitfield; *Bulletin 3, Am. Mus. Nat. Hist.*, p. 64, pl. 7, figs. 35, 36. 1882.

Shell inequilateral, sub-quadrangular, gibbous; anterior end short, rounded; posterior end broader, abruptly compressed, vertically truncated at the extremity; beak nearer the anterior end, small; posterior umbonal slope extremely gibbous (a

broad undefined ridge) reaching to the base of the truncation. Surface marked by fine regular concentric lines parallel to the border of the shell.

Length, .11 to .13; width, .08 to .10 of an inch.

This species is much smaller and less nearly equilateral than the preceding, with a more gibbous umbonal region. The posterior end is abruptly truncate, the truncation slopes upward and outward from the base. In this respect it is the reverse of *C. subelliptica*, which is more elliptical and obliquely truncated, the truncation not reaching to the base. It is closely related in form to *Nucula rectangularis* of McCoy.

*Locality.*—Spergen Hill, and Lanesville, Ind.

#### CYPRICARDELLA OBLONGA.

*Plate 30, Figs. 30-34.*

*Cypricardella oblonga*, HALL. Trans. Alb. Inst., vol. iv, p. 18. 1856.

*Microndon (Cypricardella) oblonga* (Hall, sp.). Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 65, pl. 7, figs. 30-34. 1882.

Shell oblong, sub-quadrangular; anterior end, narrow, rounded; posterior end broader, flattened, and almost vertically truncate; cardinal margin nearly straight and horizontal behind, declining in front; base nearly parallel to the hinge-line; beaks small, somewhat prominent, gibbous below; posterior umbonal slope gibbous or sub-angular, and extending obliquely downward and backward to the base of the truncation; lunule small, ovate, deep in the center; escutcheon linear distinct.

Length, .09 to .30; width, .06 to .20 of an inch.

This species, in some of its characters, is intermediate between *C. subelliptica* and *C. nucleata*; it is much less elliptical than the first, with the beaks more nearly anterior and more distinctly truncated; and it is much longer than the last, less expanded behind and less gibbous. The posterior truncation slopes downward and outward, and the hinge-line is straighter than in either of the others. We have specimens from the extremely young to the length of half an inch, showing in all stages a constant form which readily enables one to distinguish this form from either of the other species.

*Localities.*—Spergen Hill, Lanesville, and Bloomington, Ind.

## SANGUINOLITES? (GONIOPHORA??) PLICATA.

Plate 30, Fig. 39.

*Cypricardella plicata*, HALL. Trans. Alb. Inst., vol. iv, p. 18. 1856.*Goniophora plicata*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 66, pl. 7, fig. 39. 1882.

Shell oblong, sub-quadrate, hinge line slightly arched, the base and hinge-line nearly parallel; gibbous in the middle above, and anteriorly depressed in the middle toward the base; beaks near the anterior end small and scarcely rising above the hinge margin; anterior end short, scarcely extending beyond the beak, and rounded; posterior extremity doubly truncate, a strong fold or angulation extending from the umbo to the posterior basal margin, and a smaller similar fold midway between that and the hinge-line, the intervals between these being truncate. Surface marked with concentric lines of growth.

Length, .12; width, .12 of an inch.

This species is characterized by the two folds or angulations on the posterior slope, giving a double truncation; the upper one, from the hinge to the first fold, slopes outward, while that from the first to the second fold slopes toward the base, making the greatest extension of the shell an obtuse angle at the upper fold. These folds are continued nearly to the beak of the shell. The lower part of the shell, near the middle of its length, is slightly depressed, but this depression scarcely reaches the margin.

A specimen from Spergen Hill shows plications on the posterior slope. So far as can be determined at present this specimen is only a variety of *C. plicata*. The generic relations of this shell have not been determined. [This shell is not congeneric with the preceding, and if the hinge be not crenulate, it is more nearly allied with *Sanguinolites* or *Pleurophorus*, but is not properly a *Goniophora*.]

*Locality*.—Spergen Hill, Bloomington and Lanesville, Ind.

CYPRICARDINIA, *Hall.*

## CYPRICARDINIA INDIANENSIS.

*Plate 30, Figs. 10-14.**Cypricardia Indianensis*, HALL. Trans. Alb. Inst., vol. iv, p. 18. 1856.*Cypricardia* (?) *Indianensis*, (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 58, pl. 7, figs. 10-14. 1882.

. Shell elongate-ovate, narrow and rounded in front; posterior end broader, compressed and sub-alate; base broadly curved; hinge line straight, less than the greatest length of the shell; a line or groove on the inner margin extending from the beak to the posterior extremity; beaks very small, near the anterior end; umbonal region gibbous. Surface marked by distinct, regular, imbricating lamellæ.

Length, from one-eighth to one-fourth of an inch.

This species in general aspect is not unlike several others, occurring in different positions in Silurian and Devonian rocks. A comparison of specimens, however, shows them to be distinct. The gibbous umbonal region, elongate-posterior side, and strong, undulating concentric laminæ are distinguishing features.

[The generic relations of this shell have not been satisfactorily determined.]

*Localities.*—Alton, Ill.; Spergen Hill, Bloomington, and Lanesville, Ind.

## EDMONDIA [??] SUBPLANA.

*Plate 30, Fig. 38.**Cypricardia subplano*, HALL. Trans. Alb. Inst., vol. iv, p. 19. 1856.*Edmondia subplana*, (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 66, pl. 7, fig. 38. 1882.

Shell ovate oblong; anterior end very short; posterior end extremely elongate, very gradually narrowing to the extremity which forms a symmetrical elliptic curve; cardinal and basal margins nearly parallel; beaks small; umbonal region depressed convex. A few obsolete concentric folds visible on the surface; intermediate portions probably finely striate.

Length, .69; width, .38 of an inch.

This differs conspicuously from the preceding in its form, which gradually narrows behind with no indication of expansion toward the hinge line. The umbonal slope is somewhat depressed convex, and the whole shell has a flattened appearance. The surface markings have been nearly obliterated by wearing.

[The generic relations of this shell have not been satisfactorily determined. It does not belong to the genus *Cypricardia* as we now know, and is too unlike the typical forms of *Edmondia* to be placed under that genus, except with extreme reservation.]

*Locality*.—Spergen Hill and Lanesville, Ind.

## NUCULA, *Lamarck*.

### NUCULA SHUMARDANA.

*Plate 30, Figs. 2-6.*

*Nucula shumardana*, HALL. Trans. Alb. Inst., vol. iv, p. 16. 1856.

*Nucula shumardana*, HALL. Whitfield: Bulletin 3, Am. Mus. Nat. Hist., p. 57; pl. 7, figs. 2-6.

Shell obliquely ovate or sub-cuneate, gibbous toward the beaks; beaks anterior, elevated, approximate, or in contact; anterior end vertically truncate; posterior side cuneate, sloping from the beak; cardinal line forming an angle of about  $80^\circ$  at the beak; base forming a broad curve from the anterior and posterior cardinal margins; surface marked by regular equidistant, sub-imbricating striæ, rarely with unequal concentric folds; hinge-line somewhat strongly crenulate; ligamentary pit distinct, triangular.

Length, .09 to .21; width, .08 to .17 of an inch.

This is a pretty and neat species, distinguished by an obtuse anterior extremity, which forms less than a right angle with the posterior cardinal margin. The shell is gibbous toward the beak, abruptly rounded in front, and sloping toward the posterior extremity.

*Localities*.—Spergen Hill, Lanesville, and Bloomington, Ind.



LEDA, *Schumacher*.

## LEDA NASUTA.

*Plate 30, Figs. 7-9.**Nucula nasuta*, HALL. Trans. Alb. Inst., vol. iv, p. 17. 1856.*Nuculona nasuta*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 57, pl. 7, figs. 7-9. 1882.

Shell sub-ovate, abruptly contracted behind; anterior extremity rounded; beaks prominent, sub-central; posterior side shorter and contracted, both laterally and vertically into a proboscoidal extension; surface marked by regular lines of growth.

Length, .14; width, .09 of an inch.

*Localities*.—Spergen Hill and Lanesville, Ind.

CONOCARDIUM, *Bronn*.

## CONOCARDIUM CATASTOMUM.

*Plate 30, Figs. 15-17.**Conocardium catastomum*, HALL. Trans. Alb. Inst., vol. iv, p. 13. 1856.*Conocardium catastomum*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 58, pl. 7, figs. 15-17. 1882.

Shell very small, elongate, sub-cylindrical or sub-clavate, gibbous in the middle; beaks minute, rising slightly above the hinge-line, and anchylosed; anterior end obliquely truncated and obtusely angular on the umbonal slope; the anterior tubular wing minute; posterior end much extended, and constricted near the middle, swelling at the extremity and gaping below; surface marked with small, simple, radiating folds, which sometimes become obsolete on the anterior end and umbones; minute, undulating, concentric striæ cross the radiating folds in well preserved specimens.

Length, from 125 to .20 of an inch.

This species is readily distinguished by its elongate form and minute size (varying from one-eighth to one-quarter of an inch in length), its gibbous anterior end, and the constriction near the middle of the posterior half of the shell. The posterior extremity becomes suddenly expanded or tumid behind the constriction, and presents a comparatively large ovate hiatus below.

*Localities*.—Spergen Hill and Lanesville, Ind.

## CONOCARDIUM CARINATUM.

Plate 30, Figs. 18, 19.

*Conocardium carinatum*, HALL. Trans. Alb. Inst., vol. iv, p. 14. 1856.

*Conocardium carinatum*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 59, pl. 7, figs. 18, 19. 1882.

Shell sub-trigonal, gibbous in the middle, anterior end cordate; hinge line straight; beaks very small, strongly incurved, rising little above the hinge line; posterior side straight above, sloping upwards from below, and gradually tapering to the extremity, faintly constricted at its junction with the body of the shell and gaping below; hiatus elongate lanceolate, crenulate; umbonal slope strongly carinated; carina reaching from beak to base, where it is strongly salient; anterior side obliquely truncate, and abruptly produced into a small conical tubular extension of the hinge-line. Surface marked by simple radiating ribs, and extremely fine concentric striæ, which, in passing over the ribs give the surface a granulated appearance. On the anterior slope the ribs are finer and closer than on the sides of the shell, and strongly curved.

Length, from .20 to .33 of an inch.

This species is distinguished from the others described by the strong carina, which becomes alate on the lower part of the shell, from the abrupt slope of the base of the posterior side and narrow elongate hiatus. In unworn specimens, the fine concentric lines in crossing the ribs, produce minute granulations, which are seen only with a good lens. The anterior extremity of the shell is broadly cordate with a minute conical wing above; some of the ribs, which are distinct near the base, coalesce with the carina before reaching the beak.

*Localities*.—Spergen Hill, Lanesville, and Bloomington, Ind.

## CONOCARDIUM CUNEATUM.

Plate 30, Figs. 24-26.

*Conocardium cuneatum*, HALL. Trans. Alb. Inst., vol. iv, p. 14. 1856.

*Conocardium cuneatum*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 60, pl. 7, figs. 24-26. 1882.

Shell sub-trigonal or abruptly clavate; hinge-line straight; beaks anchylosed, incurved, very small, rising but little above

the hinge-line; umbonal slope angular; anterior side truncate, concave just within the angle of the umbonal slope, convex in the middle, and abruptly produced above, in continuation of the hinge-line, into a tubular wing; posterior side vertically compressed, straight along the hinge-line, and abruptly declining at the extremity, sloping along the base from the center of the shell to the extremity. Hiatus elongate, extending forward to near the middle of the shell, rounded and expanded at the posterior extremity, and deeply crenulate in the margins of the narrower part. Surface marked by distinct radiating costæ, which often alternate in size or bifurcate on the posterior part of the shell, crossed by fine elevated concentric lines of growth, more or less closely arranged. Near the basal margin are some stronger sub-imbricating ridges parallel to the lines of growth.

Length, .33 to .50 of an inch.

This shell resembles *C. carinatum*, but it is larger and proportionally thicker, the ribs are less distinctly angular on the anterior umbonal slope, and less regular, especially on the posterior side of the shell, just behind the more gibbous part, where they often bifurcate or alternate in size; also, the concentric lines are stronger, and there is no evidence of granulations at the crossing of the radiating and concentric lines. The shell is remarkable as being vertically compressed or pinched toward the posterior extremity, where the sudden declination of the cardinal margin gives it an abrupt wedge-shaped termination. The cardinal margins are distinctly anchylosed and the posterior edge of the hiatus at the junction of the two valves is distinctly continuous.

*Localities.*—Spergen Hill, Lanesville, and Bloomington, Ind.

#### CONOCARDIUM PRATTENANUM.

*Plate 30, Fig. 20.*

*Conocardium prattenanum*, HALL. Trans. Alb. Inst., vol. iv, p. 85. 1856.

*Conocardium prattenanum*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 61, pl. 7, fig. 20. 1882.

Shell sub-fusiform; hinge-line straight, beaks depressed, distinctly anchylosed; from the beaks along the anterior umbonal slope the angle is obtuse and scarcely defined; anterior

side obtuse, convex in the middle, and gradually sloping upward from the angles; posterior part of the shell with a broad depression on each side, and again expanding at the extremity with an oblique angular fold, from the hinge-line downward to the hiatus; hiatus broad and expanded behind, narrowed abruptly at the junction of the oblique folds, and thence gradually to the middle of the shell. Surface marked by strong plications, which are much stronger on the anterior part of the shell, and more slender behind. The fold along the anterior umbonal slope bifurcates, sending off on each side a plication, which again bifurcates. Plications crossed by sharply elevated lines, which are more conspicuous on the posterior part, give it a cancellated appearance.

Length, .20' of an inch.

This species differs from either of the preceding in the greater prominence of the anterior end, which is likewise more strongly costate. The angle of the umbonal slope is less prominent, and it differs conspicuously from either of the others in the bifurcation of the folds. The ribs on the posterior slope are smaller than on the anterior side; in this respect being the reverse of the other species; the cancellating lines are nearly as strong as the ribs on the posterior end. The strong angles projecting from the hinge-line to the hiatus are also a marked character. The hiatus of this species is proportionally more extended forward than in any of the preceding, and does not contract so rapidly in that direction.

*Locality.*—Alton, Ills.

#### CONOCARDIUM MEEKANUM.

*Plate 30, Figs. 21-23.*

*Conocardium meekanum*, HALL. Trans. Alb. Inst., vol. iv, p. 15. 1856.

*Conocardium meekanum*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 61, pl. 7, figs. 21-23. 1882.

Shell sub-angularly ovate or abruptly clavate; hinge line nearly straight, declining at the posterior extremity and sometimes from the beaks, obliquely truncated anteriorly; anterior end convex in the middle, and margined by a narrow sulcus which reaches from beak to base, just within the obtuse angle

of the umbonal slope; posterior end sloping on the base uniformly from the center of the shell to the extremity, contracted behind the body of the shell; vertically depressed and slightly expanded laterally at the extremity. Surface marked by small elevated thread-like radiating lines, which on the posterior part of the shell are crossed by finer concentric striæ, giving that part of the shell a cancellated appearance. Anterior end depressed, marked by much fainter radiating lines crossed by nearly obsolete traces of fine striæ, which converge toward the anterior tubular wing.

Length, .20 to .33 of an inch.

This shell bears the nearest relation to *C. cuneatum*, but differs in being smaller, the umbonal slope is more rounded, and the radiating lines on the anterior end are much less strong, and this part of the shell is margined by a distinct groove or sulcus. On the body and the posterior part of the shell the radiating striæ are finer than in *C. cuneatum*, but, like that, are sometimes bifurcating.

*Locality*.—Alton, Ill.

#### CONOCARDIUM EQUILATERALE.

*Conocardium equilaterale*, HALL. Trans. Alb. Inst., vol. iv, p. 16. 1856.

*Conocardium equilaterale*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 62, 1882.

Shell triangular, sub-equilateral, scarcely gibbous in the middle; hinge-line very straight; beaks small, rising a little above the hinge-line; anterior end cuneate, sloping gradually from near the center of the shell; umbonal ridge obtuse above, nearly at right angles to the hinge, and subdividing several times before reaching the base; posterior end cuneate, very gradually sloping from the body of the shell; extremity unknown; surface marked by radiating striæ or folds, which are simple or bifurcating, and crossed by fine, regular, elevated, thread-like lines.

Length and width nearly equal, about .125 of an inch.

This shell is very different from the other species, in the thin wedge-form anterior end, which slopes upward, gradually, from the base. There is no tubular anterior wing visible. The

nearly equilateral form, slight gibbosity in the middle, rectangular direction of the angle of the umbonal slope, which is subdivided into several striæ or plications before reaching the base, are very distinctive characters.

The specimen described is deficient in the posterior extremity, and the form of the hiatus is unknown.

*Locality.*—Spergen Hill, Ind.

## GASTEROPODA.

### EUOMPHALUS, *Sowerby.*

#### EUOMPHALUS QUADRIVOLVIS.

*Plate 31. Figs. 24, 25.*

*Euomphalus quadrivolis*, HALL. Trans. Alb. Inst., vol. iv, p. 19. 1856.

*Straparollus quadrivolis*, HALL. S. A. Miller; Cat. Am. Pal. Foss. 1877.

*Euomphalus quadrivolis*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 71, pl. 8, figs. 24, 25. 1882.

Shell planorbicular, spire depressed, composed of about four turns, the inner one scarcely rising above the last volution; volutions somewhat rapidly increasing from the apex, regularly rounded; aperture round-oval, slightly transverse; umbilicus less than the diameter of the outer volution; surface marked by fine, closely-arranged striæ of growth.

Diameter, .12 to .31; elevation, .06 to .16 of an inch.

This shell is distinguished by the depressed spire, showing in profile only the second volution. The volutions are regularly rounded, never angular above or below. The umbilicus is comparatively small, the volutions increasing rapidly in size. The surface is marked by regular striæ of growth, which may be occasionally irregular from accident to the shell in its growing condition.

*Localities.*—Spergen Hill, Lanesville, and Bloomington, Ind.

## EUOMPHALUS SPERGENENSIS.

Plate 31, Figs. 16, 19.

- Euomphalus Spergenensis*, HALL. Trans. Alb. Inst., vol. iv, p. 19. 1856.  
*Straparollus Spergenensis*, HALL. S. A. Miller; Cat. Am. Pal. Fossils. 1877.  
*Euomphalus Spergenensis*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 69, pl. 8, figs. 16-19. 1882.

Shell sub-discoid or planorbiform; spire composed of five or six turns, the inner ones coiled in the same plane, two or three of the outer ones only visible in profile; suture well defined on both sides; volutions rounded below with a distinct obtuse angulation on the upper side, a little distance from the suture; umbilicus nearly twice the breadth of the outer volution; aperture oblique, round-oval with a slight expansion at the angle on the upper side of the volution. Surface marked by close, fine, equal striæ of growth.

Diameter, .30 to .1 inch; height, .23 to .25 of an inch.

This shell resembles the *E. lævis* of D'Archiac and De Verneuil. (Trans. Geol. Soc. Lond., vol. vi, 2d series, part 2, page 363, plate 38, fig. 7.) *E. planorbis*, in part of De Koninck. (Carb. Fossils of Belgium, page 434, plate 25, fig. 7.)

Our shell agrees with the description of MM. D'A. and De V., with the exception of the form of the aperture. The figures given by these authors show the greatest diameter of the aperture to be transverse, while in the species here described the longest diameter is obliquely outward and downward from the axis of the shell.

Our shells with five turns of the spire are much smaller than *E. lævis* of these authors, and our larger specimens are precisely of the same size as the four inner volutions of their figures.

It is possible, however, that these deviations which appear constant in our specimens may prove to be only a variety not of specific value. Our specimens of this species, which are numerous, do not lead us to include the *E. planorbis* of D'A. and De V. as a variety.

Our specimens present all gradations, from those with the spire entirely flat to those where the three outer volutions are visible in profile. In all these the obtuse angulation on the upper side of the volution is present.

*Localities.*—Spergen Hill, Lanesville, and Bloomington, Ind.

## EUOMPHALUS SPERGENENSIS, var. PLANORBIFORMIS.

Plate 31, Figs. 20, 21.

*Euomphalus Spergenensis*, var. *planorbiformis*, HALL. Trans. Alb. Inst., vol. iv, p. 20. 1856.

*Straparollus Spergenensis*, var. *planorbiformis*, HALL. S. A. Miller; Cat. Am. Pal. Fos. 1877.

*Euomphalus Spergenensis*, var. *planorbiformis*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 70, pl. 8, figs. 20, 21. 1882.

Shell discoid; spire flat or concave; volutions about four, rounded above and below; aperture nearly circular; umbilicus broad, not deep.

This variety differs from the flattened forms of the species in the absence, or only slight indication, of the angulation on the upper side of the volution. The spire is often concave, and in such specimens there is an obtuse angulation on the upper side of the volution, but differing so much from the last described as to present a distinction from the same feature in those of the species with raised spires. The size and form of the volutions, and their ratio of increasing size, correspond with characteristic features of the species.

*Localities*.—Spergen Hill, Lanesville, and Bloomington, Ind.

## EUOMPHALUS PLANISPIRA.

Plate 31, Figs. 22, 23.

*Euomphalus planispira*, HALL. Trans. Alb. Inst., vol. iv, p. 20. 1856.

*Straparollus planispira*, HALL. S. A. Miller; Cat. Am. Pal. Fossils. 1877.

*Euomphalus planispira*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 70, pl. 8, figs. 22, 23. 1882.

Shell discoid; spire flat or scarcely concave; volutions about five or six, slender, very gradually increasing in size, rounded above and below; suture well defined; aperture circular; umbilicus broad and shallow. Surface marked by fine, closely arranged and slightly undulating striæ.

Diameter, .36; height, .12 of an inch.

This shell is distinguished from either of the preceding by its slender volutions, which increase much more gradually from the apex. The volutions are round, both above and below,



though sometimes the lower side descends so abruptly to the umbilicus as to present the appearance of an obtuse or undefined angle on the last volution.

The broad and shallow umbilicus of this species results from the flatness of the spire and the small diameter of the volutions. The volutions are as perfectly distinguishable on the lower as on the upper side of the shell.

*Localities.*—Spergen Hill, Lanesville, and Bloomington, Ind.

## PLEUROTOMARIA, *DeFrance*.

### PLEUROTOMARIA NODULOSTRIATA.

*Plate 32, Fig. 5.*

*Pleurotomaria nodulostriata*, HALL. Trans. Alb. Inst., vol. 4, p. 21, 1856.

*Pleurotomaria nodulostriata*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 80, pl. 9, fig. 5, 1882.

Shell turbinate; spire depressed-conical, obtuse at the apex; volutions about four, rounded, somewhat depressed above, the last one ventricose below; suture distinct, rather sharply defined; aperture sub-circular, slightly flattened on the inner side; umbilicus rudimentary, surface marked by strong, revolving, elevated striæ which are about equal to the spaces between them, excepting on the periphery of the outer volution where two or three are more distant, leaving a double spiral band; revolving striæ crossed by oblique striæ (parallel to the lines of growth) which are very conspicuous on the upper side of the volution, but become obsolete below the band. The revolving lines at the junction of the oblique striæ become nodulose on the upper half of the volution, and particularly near the suture.

Diameter .12 to .18; height .10 to .18 of an inch.

This little shell is distinguished by its depressed conical spire, which is almost truncate above. The external characteristics are the strong revolving striæ, only visible on the lower half of the last volution, or with but faint oblique striæ; while on the upper part of the volution, the crossings of the striæ produce a distinct nodulose or granulated surface; and this character is

the last to be obliterated in worn shells. The spiral band on the middle of the last volution consists of a single elevated line between two broad depressed spaces.

*Localities*.—Spergen Hill, Lanesville, and Bloomington, Ind.

#### PLEUROTOMARIA HUMILIS.

*Plate 32, Fig. 3.*

*Pleurotomaria humilis*, HALL. Trans. Alb. Inst., vol. iv, p. 21. 1856.

*Pleurotomaria humilis*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 82, pl. 9, fig. 3. 1882.

Shell depressed, trochiform, oblique, spire a little elevated, consisting of three or four volutions which increase rapidly in size from the apex; volutions, depressed-convex above, and declining to the periphery; base of the last volution less convex than on the upper side, sub-obtusely angular on the periphery, which is marked by a narrow groove, which is but little wider than the usual spaces between the revolving striæ; surface marked by revolving and transverse striæ, which are stronger and more distant on the upper side of the volution, giving it a beautiful cancellated appearance; while they are closer and finer on the lower side of the shell; mouth transversely oval; umbilicus small.

Diameter, .10 to .19; height, .07 to .14 of an inch.

*Localities*.—Bloomington, Lanesville, and Spergen Hill, Ind.

#### PLEUROTOMARIA MEEKANA.

*Plate 32, Figs. 8, 9.*

*Pleurotomaria meekana*, HALL. Trans. Alb. Inst., vol. iv, p. 22. 1856.

*Pleurotomaria? meekana*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 82, pl. 9, figs. 8, 9. 1882.

Shell depressed-conical; spire short; rapidly diminishing and obtuse at the apex; volutions about five, appressed above and sub-angular below, with the periphery vertical; suture distinct; last volution large, not ventricose, biangular on the periphery, with a defined groove in the center which is distinctly margined above and below by an elevated line; surface on the upper side

of the volutions marked by revolving and transverse striæ of equal strength, which are regularly cancellated (and when not worn there is a slight nodosity at the crossing.)

The revolving lines on the base of the last volution are closer and finer than those above, and equally but less distinctly, crossed by the transverse lines which make a deep sinuosity on the periphery of the shell. Aperture sub-quadrate with a deep notch on the outer margin at the termination of the revolving band; umbilicus of medium size.

Diameter, .18; height, .13 of an inch.

This species resembles the *P. humilis* in general form; but the spire is more elevated, and it has one or two more volutions, which do not increase in size so rapidly as in that species. The periphery also is straight and bounded above and below by an angular ridge, and with a distinct spiral groove, margined on each side by an elevated band of equal width to itself, the three divisions occupying the whole of the periphery. The umbilicus is somewhat larger than in *P. humilis*, and the mouth more distinctly quadrate, its outer margin being nearly vertical.

*Locality*.—Erroneously cited in the original paper as occurring at Spergen Hill.

#### PLEUROTOMARIA PIASAENSIS.

*Plate 32, Figs. 6, 7.*

*Pleurotomaria piasaensis*, HALL. Trans. Alb. Inst., vol. iv, p. 22. 1856.

*Pleurotomaria piasaensis*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 83, pl. 9, figs. 6, 7. 1882.

Shell depressed, sub-globose; spire short and little elevated, consisting of about four volutions; volutions rapidly increasing in size, depressed-convex above, somewhat rounded below, and becoming sub-angular near the aperture; the periphery abruptly rounded and marked by a spiral groove or band; surface marked by about four strong spiral or revolving striæ on the upper side of the volution, between the periphery and suture, and four or five similar striæ on the lower side; transverse striæ scarcely distinct, except on the spaces between the revolving striæ; umbilical depression rather broad and margined by a strong angular elevation toward the aperture of the shell; aperture sub-

quadrangular, the pillar side shorter; the outer side, from the periphery to the angle bordering the umbilical region, nearly straight, and equal to the space from the periphery to the suture.

Diameter, .17; height, from .10 to .11 of an inch.

This species resembles *P. humilis* in form, but differs in the stronger revolving lines, with scarcely visible transverse striæ, and also in the decided angulation bordering the umbilical region.

*Locality*.—Piasa creek, above Alton, Ill.

### PLEUROTOMARIA SUBGLOBOSA.

*Plate 32, Fig. 10.*

*Pleurotomaria rotundata*, HALL. Trans. Alb. Inst., vol. iv, p. 23. 1856.

*Pleurotomaria subglobosa*, HALL. Cat. Am. Pal. Foss.; S. A. Miller, p. 245. 1877.

*Pleurotomaria subglobosa*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 79, pl. 9, fig. 10. 1882.

Shell sub-globose; volutions about five or six, convex, the last one very rotund or ventricose; suture distinctly marked, and the volution depressed just below it, and rising in an obtuse, undefined angle, below which is a distinct depressed revolving line, and below this again a similar sub-angular elevation, which forms the upper limit of the broad periphery of the outer volution, thus making the upper side of the volution obscurely biangular, with one depression between the angles and the other toward the suture. (These angles and the depression between are distinctly visible in the cast.) Aperture broadly ovate, umbilicus small; surface marked by fine, closely arranged revolving striæ; spire broad, depressed, conical.

Diameter, .09 to .45; height, .04 to .38 of an inch.

This is a well marked and easily distinguished species, both in external characters and in casts where the outer volution is preserved. The form is globose, the periphery of the last volution is a little straightened from the angle above. The two obscure angles and the depression between them characterize the species. No distinct striæ crossing the revolving striæ have been observed. There are some obscure indications of a spiral band on the periphery.

*Localities*.—Alton, Ill.; Spergen Hill, Bloomington, and Lanesville, Ind.

## PLEUROTOMARIA WORTHENI.

Plate 32, Fig. 4.

- Pleurotomaria Wortheni*, HALL. Trans. Alb. Inst., vol. iv, p. 23. 1856.  
*Pleurotomaria Wortheni*, HALL. Geol. Rept. Iowa, p. 530, pl. 23; fig. 13. 1858.  
*Pleurotomaria Wortheni*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 81, pl. 9, fig. 4. 1882.

Shell depressed sub-globose; spire but little elevated, oblique from the great expansion of the last volution; volutions about three, somewhat flattened above, rapidly expanding, so that the last volution makes nearly the whole bulk of the shell; obtusely angular on the periphery; upper margin of the volutions marked by a row of strong nodes, which extend about one-third across; surface marked above by striæ parallel to the lines of growth which on the last volution disappear in passing over the angulate periphery; base of last volution marked by strong revolving lines on the space between the outer margin and the umbilical area; base deeply excavated about the umbilical region, but the umbilicus is unknown. Aperture sub-quadrangle, upper edge of the outer lip projecting far over the lower.

Diameter, .60; height, .48 of an inch.

In general form this species bears some resemblance to *P. spherulata* of Conrad, (*P. coronula*, Hall,) but it has fewer volutions, it is less sharply angular on the periphery, and the nodes are much stronger and extend partially across the volution; while in *P. spherulata* they are small and form an elevated crest along the suture line.

*Localities*.—Bloomington, Spergen Hill, and Lanessville, Ind.

## PLEUROTOMARIA SWALLOWANA.

Plate 32, Figs. 1, 2.

- Pleurotomaria Swallowana*, HALL. Trans. Alb. Inst., vol. iv, p. 24. 1856.  
*Pleurotomaria Swallowana*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 80, pl. 9, figs. 1, 2. 1882.

Shell depressed, somewhat globose, spire little elevated; volutions about five, regularly rounded, the last one sub-ventricose, and sometimes a little more expanded at the periphery; suture well defined; aperture sub-circular, a little oblique on the pillar;

umbilicus large, circular; a flattened band upon the periphery of the shell margined on each side by a distinct elevated line; volutions crossed by fine, even, thread-like striæ, which are smaller than the spaces between them, more conspicuous on the upper side of the volutions and often obsolete on the lower side.

Diameter, .12 to .25; height, .07 to .20 of an inch.

This species resembles a small *Helix* with depressed spire and large, rounded umbilicus. In worn specimens the striæ are often indistinct, and the revolving band on the periphery is frequently quite obliterated. When these are present, they afford, with the form, very reliable characters.

*Localities*.—Spergen Hill, Lanesville, and Bloomington, Ind.

#### PLEUROTOMARIA TRILINEATA.

*Plate 32, Fig. 20.*

*Pleurotomaria trilineata*, HALL. *Trans. Alb. Inst.*, vol. iv, p. 25. 1856.

*Pleurotomaria trilineata*, HALL. Whitfield; *Bulletin 3, Am. Mus. Nat. Hist.*, p. 80, pl. 9, fig. 20. 1882.

Shell ovate-conical; spire more or less elevated, acute at the apex; volutions about six; convex, last volution ventricose; suture distinctly defined; aperture sub-circular; columella perforate by a small umbilicus; surface marked upon the periphery by a comparatively broad spiral band, which is margined each side by a linear groove; two other similar grooves between the band and the umbilicus, dividing the base of the shell into three spaces, each one equaling in width the spiral band; entire surface, except the spiral band, ornamented by revolving thread-like striæ, which are crossed by fine lines of growth, the latter becoming stronger and curving slightly backward upon the spiral band; an almost imperceptible angulation just below the umbilicus.

Length, .25 to .50 of an inch.

In form, this shell somewhat resembles the *Cyclonema* (*Pleurotomaria*) *Leavenworthana*, but could only be mistaken for the same when occurring as casts. The distant revolving grooves on the lower part of the shell will readily distinguish it. In the better preserved condition, the finer revolving striæ, which

cover the surface, except the spiral band, together with this, are characteristic features. The spire in this species is also more acute than in the other, the volutions less uniformly rounded, and the last volution more ventricose, with a distinct umbilical perforation.

*Localities.*—Spergen Hill, Lanesville, and Bloomington, Ind.

#### PLEUROTOMARIA ELEGANTULA.

*Plate 32, Fig. 19.*

*Murchisonia elegantula*, HALL. Trans. Alb. Inst., vol. iv, p. 27. 1856.

*Pleurotomaria shumardi*, MEEK & WORTHEN. Geol. Surv. Ill., vol. ii, p. 260, pl. 18, fig. 6. 1866.

*Pleurotomaria elegantula*, (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 84, pl. 9, fig. 19. 1882.

Shell elongate-conical; spire composed of about six or seven volutions, which are obliquely flattened on the upper side, and angular near the base; suture not strongly defined, surface marked by strong elevated striæ which cross the volutions from the upper side obliquely, or with a gentle curve backward, and crossing the spiral band, which is coincident with the angle of the volution, appear below it in a nearly vertical, or slightly oblique, position to the axis of the shell; form of aperture unknown.

Length, .33 of an inch.

This very elegant little species differs from any of the others, in the strong transverse striæ, the angulation of the volutions near the lower edge, and the absence of revolving striæ.

The described specimen preserves but about six volutions, one or two having been broken from the apex.

*Locality.*—Bloomington, Spergen Hill, and Lanesville, Ind.

#### PLEUROTOMARIA CONULA.

*Plate 32, Fig. 17.*

*Pleurotomaria (murchisonia?) conula*, HALL. Trans. Alb. Inst., vol. iv, p. 26. 1856.

*Pleurotomaria conula*, (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 84, pl. 9, fig. 17. 1882.

Shell conical, spire gradually and uniformly diminishing from the base; volutions six to eight, angular in the middle, and

flattened above and below; sutures defined; surface marked by distinct, elevated, nearly vertical striæ both above and below the spiral band; spiral band occupying the periphery of the volution, and composed of three revolving minute carinations with narrow depressions between (sometimes only two elevated bands are visible); aperture sub-quadrate; columella extended below, perforate.

Length, from .08 to .18 of an inch.

This shell is almost strictly conical, the volutions sub-angular, with nearly vertical, raised striæ, which are interrupted on the spiral band, and appear only slightly below or not at all. The spiral band sometimes appears to be composed of two raised striæ with a depression between, and sometimes of three striæ. The base is flattened toward the center, and prolonged into a short canal by the extension of the columella. It is quite distinct from all other species of this group in its gradually ascending spire, its centrally angular volutions, and elongate regularly conical form.

*Localities.*—Spergen Hill and Lanesville, Ind.

## MURCHISONIA, *Phillips*.

### MURCHISONIA INSCULPTA.

*Plate 32, Fig. 18.*

*Murchisonia insculpta*, HALL. Trans. Alb. Institute, vol. iv, p. 26. 1856.

*Murchisonia insculpta*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist. p. 85, pl. 9, fig. 18. 1882.

Shell subulate-conical; spire somewhat rapidly ascending, acute; volutions six or seven, convex and rounded in the middle, oppressed and sloping gradually above and abruptly below, to the suture; upper side of volutions marked by vertical elongate nodes, which are pointed above and gradually disappear in the surface below, or subdivided into distinct elevated striæ; spiral band rather broad, margined by two distinct elevated lines with the intermediate space convex or concave; last volution ventricose, extended below, and marked by an elevated line which is a continuation of the suture line; aperture somewhat rounded, and extended in front; columella extended below and imperforate.

Length, from .05 to .25 of an inch.



This shell resembles *Pleurotomaria (Murchisonia) conula* in general form, and in some degree in external characters; but it is less strictly conical, the volutions are more rotund in the middle, the spiral band broader and more elevated, never double, the last volution much more ventricose, and the columella imperforate. The nodes on the upper margin of each volution are triangular with the apex above, and appear as if sculptured from the substance of the shell, leaving similar equal reversed spaces between each. In some well preserved specimens, these nodes become diffused below in several strong, vertical striæ, which reach the spiral band. These do not reach the lower side of the volution, which sometimes shows a single elevated revolving line. The strong elevated line on the lower side of the last volution is also a distinguishing feature.

In fragments of the shell showing single volutions, the strong nodes are a distinguishing feature. Some specimens show remains of transverse or curved striæ, but in many this character is not observable.

*Localities.*—Spergen Hill, Lanessville, and Bloomington, Ind.

#### MURCHISONIA ATTENUATA.

*Plate 32, Fig. 13.*

*Murchisonia attenuata*, HALL. Trans. Alb. Inst., vol. iv, p. 27. 1856.

*Murchisonia attenuata*, HALL. Whitfield: Bulletin. 3. Am. Mus. Nat. Hist., p. 88, pl. 9, fig. 13. 1882.

Shell subulate, elongate; spire very gradually tapering; volutions nine or more, flattened; scarcely convex in the middle and marked by a spiral band which is margined on either side by a strong elevated carina; suture bounded on each side by a sharp elevated line, which is smaller than those bordering the spiral band; aperture transverse; umbilicus closed.

This shell is extremely elongate and attenuate; the volutions, though scarcely convex in the middle, have sometimes an angular appearance from the elevated striæ or carina bordering the spiral band. The only specimen in my collection is imperfect, and the full number of volutions and form of aperture are unknown. The only surface markings distinctly visi-

ble are the two strong lines bordering the band, and one above and below margining the suture, though they have probably been minute transverse striæ.

*Locality.*—Spergen Hill, Ind.

### MURCHISONIA VERMICULA.

*Plate 32, Fig. 11.*

*Murchisonia vermicula*, HALL. Trans. Alb. Inst., vol. iv, p. 27. 1856.

*Murchisonia vermicula*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 87, pl. 9, fig. 11. 1882.

Shell cylindrical, abruptly tapering at the apex; volutions from six to ten, moderately convex in the middle, and scarcely diminishing for the first four or five turns above the base, but becoming more abruptly contracted above; the surface of each volution marked by two very prominent revolving striæ, having a space between them on the periphery and a single finer line below, and one above near the suture; the last volution not ventricose, and marked by a fifth revolving striation, which is a continuation of the suture line; aperture broadly oval, rounded below; columella imperforate. Shell minute.

Length, .14 of an inch.

This shell is very similar to *M. attenuata*, but is much smaller and more cylindrical in form, and with more convex volutions which do not uniformly diminish toward the apex, as in that species. The surface markings are similar, but the convexity of the volution along the periphery offers a contrast with the flattened form of *M. attenuata*.

*Localities.*—Spergen Hill, Lanesville, and Bloomington, Ind.

### MURCHISONIA TURRITELLA.

*Plate 32, Fig. 12.*

*Murchisonia turritella*, HALL. Trans. Alb. Inst., vol. iv, p. 27. 1856.

*Murchisonia turritella*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 88, pl. 9, fig. 12. 1882.

Shell subulate, elongate, gradually tapering to the apex; suture distinct; volutions about nine; equally rounded, the last

one slightly ventricose; surface marked by closely arranged, rounded, revolving striæ, which are stronger on the middle of the volution; fine revolving striæ on each volution of the spire, and about seven on the last volution; aperture sub-ovate; columella slightly extended and curved around the aperture imperforate.

Length, .18 to .50 of an inch.

This species has more resemblance to the genus *TURRITELLA* than to *MURCHISONIA* in its obvious characters, there being no distinct spiral band, nor variation in size of the revolving striæ. It is much larger than *M. vermicula* and readily distinguished by uniformly tapering from base to apex. There are no visible transverse striæ on our specimens.

*Locality*.—Spergen Hill, and Lanesville, Ind.

#### MURCHISONIA TEREBRIFORMIS.

*Plate 32, Figs. 15, 16.*

*Murchisonia terebriformis*, HALL. Trans. Alb. Inst., vol. iv, p. 28. 1856.

*Murchisonia terebriformis*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 86, pl. 9, figs. 15, 16. 1882.

Shell extremely elongate, subulate-acute; volutions eight or nine, very convex, marked by a broad spiral band in the center, last volution ventricose; suture deeply marked; surface ornamented on the upper side of the volutions by fine striæ; which extend obliquely backward to the spiral band; below the band by one or two spiral elevated striæ, and on the last volution by four or five similar striæ; aperture unknown; umbilicus closed.

Length, .33 of an inch.

This shell is distinguished by its extremely elongate and pointed form, with round, ventricose final volution. The periphery of the volutions above the last one is marked by a broad spiral band, while on the last it falls below the middle of the volution.

In form, this species resembles *M. turritella*, but it is a larger shell, and has no spiral lines above the band, while that species has four or five such striæ, differing from each other only in size. The volutions of that shell are less prominently rounded than in the present species.

*Localities*.—Bloomington, and Lanesville, Ind.

## MURCHISONIA VINCTA.

*Plate 32, Fig. 14.**Loxonema vineta*, HALL. Trans. Alb. Inst., vol. iv, p. 28. 1856.*Murchisonia vineta*, (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 86, pl. 9, fig. 14. 1882.

Shell extremely elongate, very gradually tapering from the base; volutions convex below, appressed above, banded just below the suture, and marked by transverse arching striæ; aperture ovate, wider below; umbilicus closed.

Length, 1 inch.

The only specimen which I have seen of this species is a fragment, preserving the aperture imperfectly, with six volutions of the spire. The specimen has all the characters of *Loxonema*, in the general aspect of the shell, appression of the upper edge of the volution at the suture, etc. In this species there is a distinct obtuse carination just below the suture; the striæ are nearly obsolete in the present specimen from abrasion. On two or three of the volutions are found some appearances of varices, but in the worn condition it can not be known if they are of specific value.

*Locality*—Spergen Hill, Ind.

CYCLONEMA, *Hall.*

## CYCLONEMA LEAVENWORTHANA.

*Plate 31, Figs. 29-31.**Pleurotomaria Leavenworthana*, HALL. Trans. Alb. Inst., vol. iv, p. 24. 1856.*Cyclonema Leavenworthana* (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 75, pl. 8, figs. 29-31. 1882.

Shell ranging in form from sub-globose to terete-conical and elongate-ovate; spire conical, varying greatly in its elevation from the young to the old shell; volutions five to seven, neatly rounded and ventricose below; suture well defined; aperture round-oval; umbilicus closed; surface marked by conspicuous, rounded, revolving striæ, which are less than the spaces between; striæ less conspicuous on the base of the last volution; the first line below the suture uniformly thinner and sharper than the others, and the spaces on each side wider.

Length, from .05 to .50 of an inch.

This species is very variable in form, depending apparently upon age; the young shell is much shorter, and the general form more globose. With age the spire becomes extended, and finally much elongated. There is no spiral band distinct from the revolving striæ; and in this respect the shell differs from the strict definition of *PLEUROTOMARIA*. In the elongated forms it is more like *MURCHISONIA*, from which it likewise differs in the absence of the spiral band.

*Localities*.—Alton, Ills.; Spergen Hill, Lanesville, and Bloomington, Ind.

#### CYCLONEMA SUBANGULATUM.

*Plate 31, Fig. 32.*

*Pleurotomaria subangulata*, HALL. Trans. Alb. Inst., vol. iv, p. 25. 1856.

*Cyclonema subangulatum*, (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 76, pl. 8, fig. 32. 1882.

Shell ovate-conical; volutions about five or six, angular above, the last one ventricose below; upper side of volution nearly rectangular to the direction of the spire; aperture ovate, the inner side straight or convex, umbilicus closed; suture distinct; surface ornamented by unequal, revolving lines, those on the lower part of the last volution finer and more closely arranged; three of those on the periphery stronger and more distant, the upper one of these three stronger than the other two forming the summit of the angle; midway between the angle and the suture is one strong angular striæ, and on the outer side, and sometimes on the inner side of this, a finer one.

Length, .35 of an inch.

This differs from any of the associated species in the angular form of the upper side of the volutions; while the revolving striæ are unequal in their size and distance from each other. There are some indications of finer revolving striæ between the coarser ones, which, in perfect shells may be distinct. In casts of this species the angular upper side is a distinguishing feature. This species resembles in form some varieties of *P. yvanii* of Leveille, and also in the angularity of the volution, but it has fewer and more irregular striæ, while in that species

they are represented as regular and numerous. No striæ parallel to the lines of growth have been observed, though doubtless they were present originally.

*Localities.*—Spergen Hill, and Lanesville, Ind.

## LOXONEMA, *Phillips.*

### LOXONEMA YANDELLANA.

*Plate 31, Figs. 35, 36.*

*Loxonema yandellana*, HALL. Trans. Alb. Inst., vol. iv, p. 23. 1856.

*Loxonema yandellana*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 77, pl. 8, figs. 35, 36. 1882.

Shell terete-subulate; spire elongate, very gradually tapering to the apex, which is apparently obtuse; volutions about eight or nine, very little convex, the last one scarcely expanded; suture distinct; surface marked by fine thread-like striæ crossing the volutions with a slight undulation above the middle; aperture ovate.

Length, .20 to .50 of an inch.

This species has a delicate subulate-terete form, the volutions very gradually increasing to the base, the last one is scarcely more expanded than those above. It is readily distinguished from any other form here described.

*Locality.*—Spergen Hill, Ind.

## EOTROCHUS, *Whitfield.*

### EOTROCHUS CONCAVUS.

*Plate 32, Figs. 21-23.*

*Pleurotomaria concava*, HALL. Trans. Alb. Inst., vol. iv, p. 24. 1856. (Name pre-occupied.)

*Pleurotomaria tenuimarginata*, HALL. S. A. Miller; Cat. Am. Pal. Foss., p. 245. 1877.

*Eotrochus concavus* (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 78. pl. 9, figs. 21-23. 1882.

Shell trochiform; spire depressed-conical; volutions about five, flattened or slightly concave above; base of shell concave; periphery alate, alation curving downward at the margin; aperture transversely ovate (the wider part at the pillar); umbilicus

of medium size, round; suture linear, rather indistinct; surface smooth or marked by obsolescent striæ, which turn abruptly backward from the suture to the periphery; similar striæ are sometimes visible on the base of the shell, bending abruptly backward on the alation.

Diameter, .25 to .75 of an inch; height, from .20 to near .50 of an inch.

The umbilicus is somewhat distinctly margined, the upper sutures are often obsolete (perhaps from wearing), and the striæ are usually but faintly visible.

If the last volution were inflated, the alation would form a distinct carination or elevated spiral band upon the periphery, presenting the characteristics of the genus, but in its present condition the shell might with almost equal propriety be referred to *TROCHUS*, or to the typical species of the genus *STRAPAROLLUS*.

*Localities*.—Spergen Hill, Lanesville, and Bloomington, Ind.

### BULIMORPHA, *Whitfield*. 1882.

\**Bulimella*, HALL. 1856.—Not Pfeiffer, 1852.

Shell fusiform or sub-fusiform (elongate); volutions of moderate convexity, the last one much enlarged; columella truncate, outer lip with a slight notch or sinus at the margin near its junction with the pillar.

The three species here described have their nearest analogies with *BULIMUS* and *ACHATINA* so far as I can at present determine. The shells can not be satisfactorily referred to any established genus.

### BULIMORPHA BULIMIFORMIS.

*Plate 31, Figs. 37-39.*

*Bulimella bulimiformis*, HALL. *Trans. Alb. Inst.*, vol. iv, p. 29. 1856.

*Polyphemopsis bulimiformis*, HALL. *M. & W.*; *Geol. Rept. Ill.*, vol. ii, p. 372. 1866.

*Bulimorpha bulimiformis*, HALL. *Whitfield*; *Bulletin 3, Am. Mus. Nat. Hist.*, p. 74, pl. 8, figs. 37-39. 1882.

Shell fusiform elongate; spire nearly equal to half the length

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[\* This generic name was preoccupied by Pfeiffer in 1852, as pointed out by Meek & Worthen in 1866, (*Geological Report of Illinois*, vol. ii, p. 372,) and was by them referred to the genus *Polyphemopsis* of Portlock.]

of the entire shell: volutions about six, slightly convex in the middle, increasing somewhat rapidly, the last one equaling in length all the others; aperture elongate-oval, acute at each extremity slightly sinuate at the upper outer angle; columella slightly curved, and truncate at the base, surface smooth or with faint lines of growth.

Length, .125 to .75 of an inch.

*Locality*.—Spergen Hill, Lanesville, and Bloomington, Ind.

#### BULIMORPHA CANALICULATA.

*Plate 31, Fig. 41.*

*Bulimella canaliculata*, HALL. Trans. Alb. Inst., vol. iv, p. 29. 1856.

*Polyphemopsis canaliculata*, HALL. M. and W.; Geol. Rept. Ill., vol. ii, p. 372. 1866.

*Bulimorpha canaliculata*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 74. pl. 8, fig. 41. 1882.

Shell sub-fusiform, somewhat elongate; spire short, scarcely equaling the length of the last volution; volutions about five, upper ones scarcely convex, rapidly diminishing to the apex; last volution longer than the spire above, slightly ventricose; suture canaliculate, the groove margined by a slight sharp carination at the upper edge of the volution; aperture, sub-ovate; surface smooth, or marked with fine lines of growth, which are abruptly bent backward at the carination on the upper edge of the volution, which marks the notch in the upper angle of the aperture.

Length, .18 of an inch.

This species differs from *B. bulimiformis* in the canaliculate suture and conspicuous carination on the upper edge of the volution. The spire is shorter in proportion to the last volution, and it has apparently one volution less. The surface markings are obscure, but the position of the lines of growth, and their abrupt backward bending upon the upper edge of the volution, show their direction.

*Localities*.—Spergen Hill, and Lanesville, Ind.



## BULIMORPHA ELONGATA.

Plate 31, Figs. 40.

*Bulimella elongata*, HALL. Trans. Alb. Inst., vol. iv, p. 30. 1856.

*Polyphemopsis elongata*, HALL. M. and W.; Geol. Rep. Ill., vol. 2, p. 372, 1866.

*Polyphemopsis teretiformis*, HALL. Cat. Am. Pal. Foss. S. A. Miller, p. 245. 1877.

*Bulimorpha elongata* (Hall, sp.) Whitfield; Bulletin 3, Am., Mus. Nat. Hist., p. 75, pl. 8, fig. 40. 1882.

Shell extremely elongate; volutions seven or eight (perhaps nine), somewhat rapidly ascending, moderately convex, the greatest convexity a little above the middle, last one slightly ventricose; suture distinct; an undefined angular elevation below, corresponding to the notch in the lip; surface nearly smooth; direction of the striæ scarcely visible.

Length .50 of an inch.

This species is distinguished from the others chiefly by the greater number of volutions, more elongate spire, and proportionally smaller body volution. The surface, as in the others, is nearly smooth, and the direction of the striæ scarcely visible.

*Locality*.—Spergen Hill, and Lanesville, Ind.

HOLOPEA, *Hall*.

## HOLOPEA PROUTANA.

Plate 31, Figs. 33-34.

*Holopea Proutana*, HALL. Trans. Alb. Inst., vol. iv., p. 30. 1856.

*Holopea* (*Callonema*?) *Proutana* (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 72, pl. 8, figs. 33, 34. 1882.

Shell ovate-conical; spire somewhat rapidly tapering; volutions about six; moderately convex, last one ventricose, sub-angular in the direction of the suture line, and obliquely extended below; suture sharply defined; aperture round-ovate, oblique on the upper side; pillar lip slightly reflexed in the umbilical region; umbilicus closed; surface marked by fine striæ parallel to the lines of growth.

Length .062 to .50 of an inch.

This shell has the appearance of a small PALUDINA, which is indeed the general aspect of the species of this genus. The last volution is ventricose and extended in front; the higher volu-

tions of the spire are moderately convex, the greatest convexity being in the middle or slightly below. The last volution shows an obtuse undefined angle in continuation of the suture line. No revolving striæ are visible upon the surface.

*Localities.*—Alton, Ill.; Spergen Hill, Lanesville, and Bloomington, Ind.

### MACROCHEILUS, *Phillips.*

#### MACROCHEILUS? LITTONANUS.

*Plate 31, Fig. 28.*

*Natica Littonana*, HALL. Trans. Alb. Inst., vol. iv, p. 30. 1856.

*Macrocheilus Littonana* (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 72, pl. 8, fig. 28. 1882.

Shell short, sub-fusiform; spire depressed-conical; volutions about four, rapidly increasing from the apex, the last volution symmetrically ventricose and prolonged below; suture not strongly marked; aperture narrow-ovate, sharp above, and narrowing near the front; outer lip thin; inner lip thickened; surface striated.

Height, .25; diameter, .19; last volution, .17 of an inch.

This shell bears a near resemblance to *Littorina pusilla* of McCoy (Carb. Foss. of Ireland, p. 32, pl. 5, fig. 26), but that shell is somewhat more elongate, with a higher spire, while the aperture is broader below, the pillar lip more arched near the front. In the present species the body volution is also a little more ventricose.

*Locality.*—Bloomington, Ind.

### NATICOPSIS, *McCoy.*

#### NATICOPSIS CARLEYANA.

*Plate 31, Figs. 26, 27.*

*Natica Carleyana*, HALL. Trans. Alb. Inst., vol. iv, p. 31. 1856.

*Naticopsis Carleyana* (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 71, pl. 8, figs. 26, 27. 1882.

Shell sub-globose; spire short, consisting of about three volutions, which increase very rapidly, the last one extremely ventri-

cose; suture not distinctly defined; aperture ovate, straight on the columella side; outer lip sharp; inner lip thickened; columella with a distinct groove near the base of the lip for the reception of the operculum; surface marked by fine, elevated striæ corresponding to the lines of growth.

Height, .10 to .30; diameter, .08 to .34 of an inch.

This little shell has the external character and general appearance of the genus *NATICA*, but differs in the absence of an umbilicus. In this respect it corresponds to the genus *NATICOPSIS*, as described by McCoy.

The shell is quite distinct in character from all others in this formation, except its congener, which has a higher spire and narrower aperture. Many of the specimens are worn quite smooth, and afford but faint traces of the striæ; and only in a few instances, near the suture, are they preserved in a perfect condition.

*Localities*.—Alton, Ills.; Spergen Hill and Bloomington, Ind.

## PLATYCERAS, *Conrad*.

### PLATYCERAS ACUTIROSTRIS.

*Plate 31, Figs. 13, 15.*

*Capulus acutirostris*, HALL. Trans. Alb. Inst., vol. iv, p. 31. 1856.

*Capulus acutirostris*, HALL. Geol. Rept. Iowa, p. 665, pl. 23, figs. 14. 1858.

*Platyceras acutirostris*, (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 67, pl. 8, figs. 13, 15. 1882.

Shell obliquely conical, more abruptly contracted above, and continued in more slender proportions to the apex, which is incurved, making about a single volution without contact with the body of the shell; aperture sub-circular, margin sinuate; surface sub-plicate, with narrow sub-angular folds and wider depressed spaces; lines of growth strong, abrupt upon the angles, and arching forward on the spaces between.

This species is not remarkably different from others of the same genus in the Carboniferous and Devonian rocks. The apex, however, is more slender, and the arching of the striæ on the surface is more extreme than I have observed in species of this form.

In other specimens the elevated folds and wide depressions do not alternate regularly, and the surface is unequally plicate or undulating.

*Localities.*—Spergen Hill, Lanesville, and Bloomington, Ind.

### BELLEROPHON, *Montfort.*

#### BELLEROPHON SUBLÆVIS.

*Plate 31, Figs. 6, 7.*

*Bellerophon sublævis*, HALL. Trans. Alb. Inst., vol. iv, p. 32. 1856.

*Bellerophon sublævis*, HALL. Geol. Iowa, p. 666, pl. 23, fig. 15. 1858.

*Bellerophon sublævis*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 89, pl. 8, figs. 6, 7. 1882.

Shell sub-globose, inflated on the last volution; aperture transverse, arcuate, expanded, the lip thickened and much extended at the junction with the volution; umbilicus closed; dorsum carinated by a narrow slightly elevated carina; surface ornamented by fine, regular striæ which bend abruptly and deeply backward on the carina, denoting the depths of the emargination of the lip; striæ sometimes irregular from interrupted growth.

Length, from half to one inch.

This shell differs from the preceding in its larger size, and more globose character of the outer volution, exhibiting no flattening across the dorsum. It differs also in the absence of longitudinal striæ and umbilicus. In worn specimens the striæ and carina are often quite obliterated; and the general form of the shell is the only guide to its specific distinction.

*Localities.*—Alton, Ill.; Spergen Hill, Lanesville, and Bloomington, Ind.

#### BELLEROPHON TEXTILIS.

*Plate 31, Figs. 4, 5.*

*Bellerophon cancellatus*, HALL. Trans. Alb. Inst., vol. iv, p. 31. 1856.

*Bellerophon textilis*, HALL. Cat. Am. Pal. Foss., S. A. Miller. 1877.

*Bellerophon textilis*, (Hall, sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 90, pl. 8, figs. 4, 5. 1882.

Shell sub-globose; aperture transversely oval, arcuate, with the lip reflexed at the sides; umbilicus small in young shells,

and scarcely visible in the older specimens from the thickening of the lip; surface marked by fine longitudinal reflected striæ, of which about thirty may be counted on each side of the carina increasing by implantation with the age of the shell; carina rather narrow and little elevated, very indistinctly marked by the longitudinal striæ. Transverse striæ, in the direction of the lines of growth, irregular, sub-imbricate, more distant than the longitudinal striæ, bending backward on the carina. At the crossing of the two sets of striæ the surface is slightly nodulose, in well preserved specimens.

Length, .125 to .75 of an inch or more.

This beautiful species resembles the *B. decussata* of Fleming; and it is with some hesitation that I propose a different designation. But our shell is less distinctly umbilicate; and both the longitudinal and transverse striæ appear to be closer in that species than in this one, while the spiral band is narrower and less conspicuous, and is faintly marked by three of the longitudinal striæ. In our species the transverse striæ likewise bend more abruptly backward on the carina, than is represented in *B. decussata*.

*Localities.*—Spergen Hill, Lanesville, and Bloomington, Ind.

## PTEROPODA.

### CONULARIA, *Miller*.

#### CONULARIA SUBULATA.

*Plate 31, Fig. 3.*

*Conularia subulata*, HALL. Trans. Alb. Inst., vol. iv, p. 32. 1856.

*Conularia subulata*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 91, pl. 8, fig. 3. 1882.

Shell quadrangular, the four sides nearly flat, and converging at an angle of about  $18^{\circ}$ ; surface marked with a distinct longitudinal groove on each of the angles, and numerous regular, smooth, closely-arranged, elevated, transverse striæ, which pass a little obliquely downward toward the middle of each of the sides, when they meet at a very obtuse angle. A single sharp

longitudinal line passes down the center of each side, without interrupting the transverse striæ; angles truncate or rounded toward the apex.

Length, .50 of an inch.

*Locality*.—Alton, Ill.

## CEPHALOPODA.

### NAUTILUS, *Breyn.*

#### NAUTILUS CLARKANUS.

*Plate 31, Fig. 1.*

*Nautilus clarkanus*, HALL. Trans. Alb. Inst., vol. iv, p. 32. 1856.

*Nautilus clarkanus*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 92, pl. 8, fig. 1. 1882.

Shell sub-discoidal, flattened on the dorsum [ventrum], and angular at its lateral margin; umbilicus large, showing all the inner volutions; volutions (number unknown) rapidly diminishing, broader than high, not embracing; surface ornamented by a deep revolving groove round the dorso-lateral [ventro-lateral] margin, between which and the umbilicus, is a single row of indistinct nodes, and about five or six strong striæ, which are crossed by fine elevated striæ. Aperture transversely oval; septa slightly concave, and separated by spaces about equal to one-fourth the greater diameter of the volutions.

The specimens described is somewhat worn upon the dorsal [ventral] side, which may have obliterated the fine transverse or longitudinal striæ, remaining upon the lateral edge of the shell.

*Localities*.—Spergen Hill, and Lanesville, Ind.

### ORTHO CERAS, *Breyn.*

#### ORTHO CERAS EPIGRUS.

*Plate 31, Fig. 2.*

*Orthoceras epigrus*, HALL. Trans. Alb. Inst., vol. iv, p. 33. 1856.

*Orthoceras epigrus*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 91, pl. 8, fig. 2. 1882.

Shell sub-cylindrical, very gradually tapering; section circu-

lar; siphuncle small, sub-central; septa slightly concave, separated by spaces equal to about one-third the diameter of the shell; surface marked by distant, rather faint, longitudinal lines.

This species resembles *O. munsterianum* of de Koninck, but it is much smaller, less tapering, and has more distant septa. It also appears to differ in the surface markings, having traces of faint longitudinal lines, while that species is smooth.

*Locality*.—Spergen Hill, and Lanesville, Ind.

## ANNELIDA.

### SPIRORBIS, *Lamarck*.

#### SPIRORBIS ANNULATUS.

*Plate 32, Fig. 30.*

*Spirorbis annulatus*, HALL. Trans. Alb. Inst., vol. iv, p. 34. 1856.

*Spirorbis annulatus*, HALL. Whitfield; Bulletin 3, Am. Mus. Nat. Hist. p. 92, pl. 9, fig. 30. 1882.

Shell planorbicular, more or less ascending, irregular, spiral; spire composed of about three turns, which are contiguous or more or less disconnected; umbilical side more or less deep and regular, according to the regularity of the spiral; surface ornamented with strong annulations, with finer striæ between.

Diameter from .062 to .25 of an inch.

This species, like others of the genus, is very irregular in its convolutions, being sometimes almost entirely disjointed. The two first volutions are often in the same plane, while the succeeding one becomes deflected or extremely irregular. Some individuals are quite regular throughout. In worn specimens the annulations are partially worn off, and appear only as transverse nodes upon the surface.

*Localities*.—Alton, Ill.; Spergen Hill, Bloomington, and Lanesville, Ind.

## SPIRORBIS NODULOSUS.

Plate 32, Fig. 31.

*Spirorbis annulatus*, var. *nodulosus*, HALL. Trans. Alb. Inst., vol. iv, p. 34. 1856.

*Spirorbis nodulosus* (Hall sp.) Whitfield, Bulletin 3, Am. Mus. Nat. Hist., p. 93, pl. 9, fig. 31. 1882.

Shell in form like the preceding; last volution strongly deflected; volutions sub-angular, marked by oblique striæ or ridges, which become strongly nodulose on the umbilical side, and particularly towards the aperture.

*Locality*.—Spergen Hill, and Lanesville, Ind.

## CRUSTACEA.

LEPERDITIA, *Roualt*.

## LEPERDITIA CARBONARIA.

Plate 32, Figs. 24, 27.

*Cythere* (misprint for *Cytherina*) *Carbonaria*, HALL. Trans. Alb. Inst., vol. iv, p. 33. 1856.

*Leperditia Carbonaria* (Hall sp.) Whitfield; Bulletin 3, Am. Mus. Nat. Hist., p. 94, pl. 9, figs. 24, 27. 1882.

Shell oval or sub-ovate, gibbous, slightly compressed toward the margins, ventral [dorsal] margins straight, one-third less than the greatest length of the valves; extremities rounded, broader anteriorly; dorsal [ventral] margin forming a broad curve; surface smooth.

This species does not exceed a single line in length. Compare with *C. pusilla*, McCoy.

*Localities*.—Spergen Hill, Bloomington, and Lanesville, Ind.





# DIATOMACEÆ.

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## DIATOMS OF THE WATERS OF INDIANA.

BY REV. GEO. L. CURTISS, M. D., D. D.

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The microscopist very soon finds in all waters, salt and fresh, an innumerable host of exceedingly small, beautifully marked, and singularly shaped microscopical bodies, which have received the general name, Diatom. They form the "last division of the Algæ group, and occupy the same relation to vegetables as do the infusoria to the animal kingdom." What is usually seen by the microscopist is only the shell of the diatom, composed of pure silicon. There are two shells inclosing the vegetable matter, called the frustrules, "between which is the small connective band which divides the body into two parts." In the interior is the endochrome or coloring matter, usually of a yellowish brown color or a deep green, with a few oil drops, either clear or of a slightly yellow-brown. These oil drops are not always present.

Diatoms are found extensively in fresh and salt water. A few are common to both. Those from salt water are usually larger than those from fresh water, but are not any more beautiful to the eye or interesting to the naturalist.

It was once supposed that the salt water possessed many more and richer varieties than the fresh, but late investigations show that old ponds, lagoons and bayous of our Western rivers are as rich in varieties, having as delicate and intricate markings as any portion of the ocean. Running brooks are fine places to find varieties not inhabiting still water, while the clear and purling waters of the springs of our county furnish varieties equalling any in delicacy and beauty.

As fossil, diatoms are found in abundance such as to render them an important factor in the study of the minute structure of the rocks. At Blin, in Bohemia, is a bed of diatoms 130 feet thick. They are mostly of the kind known as "*Navicula*," and exist in numbers beyond calculation. At Plauitz, Saxony, exists a bed of fresh water diatoms, showing that in earlier geological ages there were immense fresh water ponds, as now. The city of Berlin rests on a clayey peat 60 feet thick, composed of diatom fragments. At "Wismar, on the Baltic, there is deposited every year, as appears from official documents, 228,854 cubic feet of mud, and the accumulation has continued at this rate for more than a hundred years." These mud banks were found by Ehrenbergh to present "on an average one-tenth part of the entire mass" of diatoms, partly living and partly only the shells. At this rate the annual deposit of diatoms at Wismar was 22,885 cubic feet. "In the mud banks of Pillau the remains of diatoms were found to be in greater abundance than in those of Wismar." The mud deposited by the Elbe is nearly one-half the flinty shells of diatoms. "A mud bank in Victoria Land, 400 miles long and 120 broad, is composed of silicious valves of diatoms."

Along the Atlantic coast of the United States the same thing has been observed. At Boston harbor, in the marine marshes and around New Haven, Conn., also in the marshes of Amboy, N. J., the same prevalence of diatoms is observed. Richmond and Petersburg, Va., are built on diatom beds 18 feet thick. Lake Boa, in the Island of Mull, Scotland, furnished Prof. Gregory with 130 new species. Prof. Bailey discovered, near West Point, a remarkable layer or deposit of fossil diatom. "This deposit," he says, "is about a foot below the surface of a small peat bog, immediately at the foot of the southern escarpment of the hill on which the celebrated Fort Putnam stands. In draining this bog a large ditch was dug, and among the matter thrown out my attention was attracted by a very light white or clay-colored substance, which, when examined closely in the sunshine, showed minute, glimmering, linear particles. On submitting it to observation, by means of a good microscope, I found it to be almost entirely composed of fossil organisms," a large portion being diatoms.

You may take fish from either salt or fresh water, and exam-

ine the contents of the stomach by the microscope, and in most cases there will be found quantities of diatoms, unaffected by the process of digestion. How the fish utilizes diatoms in growth we can not tell, but that they are found in the fish has often been demonstrated.

The guano imported from the southern islands, and so largely employed for fertilizing, is found to contain immense numbers of "diatomaceous structures of great elegance and richness, and, as we gaze upon these minute cases, we can not fail of being struck with the fact of the great resistance to decomposition which they possess. In this instance they must have gone through the process of digestion twice, and been subjected to the action of the elements for centuries," guano being the droppings of birds after feeding upon the fish which had fed upon the diatoms. "But under all these influences they continue unchanged, and the eye of the naturalist at last detects these minute structures still possessing their original beauty, with the delicate tracery of their rich configurations, almost as sharp and clear as it was, perhaps, a thousand years ago."

Let us go out to a pond or marsh in any portion of Indiana and see what will come to our glass. We will find more or less green scum growing on the water, besides a great variety of short hairs or masses of sponge-like substance attached to sticks and stones in the water. There will be long, green, waving filaments, noticeable for their slenderness, and a slimy or gelatinous substance, holding to everything in the water. The green scum is one form of Algæ, a most delicate vegetable of the Cryptogamic form. The waving or oscillating filaments are another kind of Algæ. The sponge-like substance is still another form of Algæ, while attached to, and growing more as a parasite to the Algæ, there may be found another vegetable called the Diatom, though classed with the Algæ. In the slimy, gelatinous substance will be found also diatoms of almost endless variety. The mud deposit of these ponds will be found composed of an average of forty per cent. of Diatom shells, from which they may be readily separated by various processes for examination. The variety of forms and markings arrest attention, and the inquirer studies the character of these little things with an ever increasing wonder.

Take a portion of water known to contain a large number of Diatoms, pour in a small quantity of nitric or sulphuric acid and boil for some minutes. Wash out the acid remaining, and place a drop of this water on a slide under the microscope and you discover the shell cleaned of all foreign substances and remaining as bright and beautiful as if no corroding acid had ever been placed upon it. If, into the water containing Diatoms hydro-fluoric acid is dropped and allowed to stand for a time, "the cellular membrane of vegetable nature is formed beneath, having the same striæ and design as the silicious coat." May we not have here the secret of the Diatom growth? The vegetable bioplasm, endowed by its Creator with its distinctive powers, grows with its individual striæ and markings, eliminating from the water that kind of matter which is silicious, suitable for its protection, and causes it to deposit upon itself with its own individual markings. The shell thus formed becomes a shield for protection to the delicate algæ it encloses.

"The Academy of Genoa has published a paper by Count Castrea," says a recent number of the *Journal of Microscopy*, "on the importance of diatoms in the formation of the earth's crust. Owing to the indestructible nature of their shells, the author believes that fossil diatoms enable him to demonstrate that in the vegetable kingdom 'the fixity of species is a constant law.'"

The most casual observer can not but discover the striking resemblance between diatoms known to be fossil, and those of the present growth.

A careful study of diatoms, ancient and modern, fossil and recent, reveals the fact that the laws of nature as to chemistry, vegetable life, form and relations, are the same, though separated by thousands of years. If this were not so, we should expect to find between diatoms of ages ago differences so marked, when subjected to the action of laws of to-day, that the tyro in observation could see them. But as it is, the most careful and rigid examination and subjection to tests, both chemical and microscopical, reveal no differences, save in an endless variety of markings and forms. The mathematics of God knows no variable quantity.

The movement of diatoms is a phenomenon not fully ex-

plained. The microscopist, when viewing diatoms fresh from the water, will not fail to observe that some of them have a considerable motion, moving forward and backward, and turning completely around, as if moved by force of will. It was this movement that led earlier students to class these as infusoria. It is now pretty well established that they are vegetable bodies, covered with plates of siliceous matter. But the movement is something difficult of explanation. I have found that most of the moving diatoms are surrounded by a cloud of jelly, and sometimes a number of small cilia are seen attached to the edges, and have at times a slight movement. These pseudocilia are not always present. Even when absent the diatom may move. When diatoms have been boiled either in clear water or in acid, they lose the flocculent matter surrounding them, and possibly in which they grow, and at the same time lose the power of locomotion. This fact, often observed, leads me to believe that the jelly surrounding the diatom is in some way the cause of the movement of diatoms.

Dr. Max Schultze, of Bonn, takes the position that the presence of oil globules in the diatom may, by its repulsion, account in part for this movement. That there exists oil globules can not well be disputed, after the results of his continued experiments. He thinks that these, by repelling the water, may thus proceed through the water. Dr. Schultze expresses doubt as to a free motion of diatoms in water, unless they can touch something by their raphæ or midrib by which it has resistance afforded sufficient to cause true motion. He thinks the motion is due to coming in contact with the cover glass, or the slide with its raphæ. I hardly think this can be so, for having placed *naviculas* in a watch crystal, I have examined them when no cover glass could come in contact with the diatom, and during such times have seen the movements nearly or quite as marked as when under a cover glass.

Since writing the above, I find that Dr. Schultze speaks of the existence of this jelly-like cloud around most diatoms in a natural state, and calls it the "sarcodæ," but does not attribute to it very great influence in the movements.

Professor Smith, of America, has observed and traced the outline of this "sarcodæ." A microscopist at Buffalo, N. Y., has made some interesting observations on the movements of

diatoms in the Niagara waters, which harmonize with the theory of motion dependent upon the jelly-like substance surrounding the body of the diatom.

There are some diatoms common to all ponds, running streams, lakes, seas and oceans. They seem to be cosmopolitan. These are usually found among the *Navicula*, *Fragilaria*, *Synedra* and *Pleurosigma*. They are found in all waters, in all zones, and exist as fossil and recent. But each locality will reveal some diatoms peculiar to itself, and which may be taken as indigenous to that particular water. Samples of water from various ponds and streams of Indiana reveal a variety of diatoms as great as any State in this Union, or possibly any country on the globe. Dr. Van Heurck has published engravings of 1,700 different varieties of diatoms found in the waters of Belgium; and still that industrious microscopist and his able assistants are finding new varieties almost each week. It may be confidently affirmed that the waters of Indiana are as rich in diatoms, and present as many varieties, as do the waters of Belgium. The diligent microscopists of Indiana need not long for the sweet waters of other countries to employ their time in examinations when the waters of their own State are teeming with beauties waiting to be found and studied. It may sound grand, and have a smack of learning, to say: "I have in my cabinet water with specimens from the Baltic, the Nile, or the Elbe," but it will sound more like home research and hearty love for making contribution to science when the microscopist can say: "I have specimens from the Wabash, the Maumee, the White Water, the Sugar Creek, Missisnewa, the Muscatatuck, the Ohio, and the hydrants of Indianapolis."

Diatoms live and grow at all seasons of the year. Cold may possibly retard growth and multiplication, but does not stop either. From the hydrant located at the corner of South and East streets, Indianapolis, during the cold winter of 1880 and 1881, I took specimens nearly every day of the season. At no time did I go there for specimens of algæ and infusoria but I found them in abundance, accompanied always by great numbers of diatoms in a fresh, growing state. I have taken them from water that was freezing cold, which could not congeal because it was flowing from the bowl of the fountain, and still they were as frisky as ever.

“What may be the benefit derived from a thorough study of these infinitesimal bodies?” is asked by the would-be utilitarian. The answer is three-fold:

1. It is educational to know what exists around us. We may have been led to suppose that only those things are noble and valuable that can be seen by the unaided eye. The microscope reveals even as beautiful, if not more beautiful, things in the lesser world, and so the mind and heart are led to a higher education.

2. The study of diatoms reveals clearly and undisputably the unity of the laws of nature. The laws controlling in the geological ages were the same as are existing in the present age. The mind that planned and executed then is planning and executing now. Nature has never been given over to unguided and lawless forces, but He who first took the reins of government, and guided the material universe, continues in the same work. The demonstration of this one discovery alone is reward enough for all the labor, money, patience and time put into its study.

3. There is some connection between the immense quantities of diatoms in pond water and the fertilization of soil by alluvial deposits. Ehrenberg found that the earth washed down by the Nile and spread out over the Delta of Egypt was composed largely of diatoms. It has long been known that bottom lands overflowed by the flooded river or creek become thereby exceedingly rich. On examination, diatoms are present in great abundance. The draining of a pond leaves rich and productive soil, wherein diatoms form no small part of the deposit. Just how diatoms become a source of wealth, or act as a fertilizer, has not been discovered, but that they are such can not be disproved.

Indiana diatoms possess a special interest to microscopists of the State. I present herewith carefully executed drawings from the microscope of 104 varieties of fresh water diatoms, taken from the hydrant and pond waters in and around Indianapolis, within a radius of four miles, except four specimens which were obtained in the waters at Shelbyville, Greenwood and Zionsville, Indiana. Could the same kind of careful examination and drawings be made of the various localities of Indiana, there is no telling what would be the revelations. Our waters are not poverty stricken as to intensely interesting



objects of natural history, but they are rich in material. When turning our attention to this field, we may say with one of old, "The half has not been told." What is here presented, it is hoped, will be only a pioneer work to what may follow when properly encouraged.

In the prosecution of this work I have been greatly aided by Dr. J. M. Mansfield, of Indiana Asbury University, who kindly loaned me "The Synopsis of Diatoms of Belgium, by Dr. Van Heurck, published in parts, commencing in 1880." This recent work is the most valuable of all that were consulted, because of its simplicity and accuracy.

Dr. F. S. Newcomer, of Indianapolis, an enthusiast in microscopical studies, aided greatly in obtaining classification and names, and in testing the work by loaning me his "Diatomacean-Typen-Platte," of J. D. Moller. The value of this "Platte" as a test of work done is beyond estimate.

In the Indiana State Library I also found "A. Schmidt's Atlas der Diatomaceenkunde," though this did not prove so valuable an aid as the work of Van Heurck in the nomenclature, yet in its geographical department it is excellent.

From Hon. T. B. Redding, Ph. D., of New Castle, Ind., an expert microscopist, I received from time to time important suggestions and words of encouragement.

At last, the drawings were put into the hands of C. M. Vorce, of Cleveland, O., a gentleman every way competent to examine and decide upon the correctness of such work. His copious notes and suggestions have been carefully studied, and mainly adapted and made a part of the work.

In this Synopsis of Diatoms of Indiana, I have adhered rigidly to a scale of 450 to 500 diameters, except in a few instances, where in the explanations I have noted higher powers. My reason for so doing was to furnish something that the younger microscopist can use to advantage. Most persons pursuing this study can obtain an objective giving from 400 to 500 diameters, but comparatively few can or will obtain higher powers. For this reason, it seemed preferable to bring this study to a line which might be made beneficial to others.

## ERRATA.

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- Page 34—A great error was made by the printer in omitting in this diagram the east-west lines through the center of each section, at the half-mile post.
- Page 100, Line 2—For "*Moses M.*" read "Moses N. Elrod."
- Page 141, Line 2 from bottom—For "*tile*" read "till."
- Page 157, Line 2 from bottom—For "*past glacial*" read "post glacial."
- Page 166, Line 8 from bottom—For "*Spirifer*" read "Rhyconella stricklandi."
- Page 183, Line 18—For "*after*" read "during."
- Page 188, Line 23—For "*found*" read "formed."
- Page 321, Line 15 from bottom—For "*Forminifera*" read "Foraminifera."



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PLATE I.

*INDEMNITATE OWENI* *Eol.*

Page 241

Fig. 1. Upper view of a specimen.

*INDEMNITATE STEINERII* *Eol.*

Page 242

Fig. 2. The lower (occipital) side of a cephalon.

Fig. 3. Transverse section, enlarged.

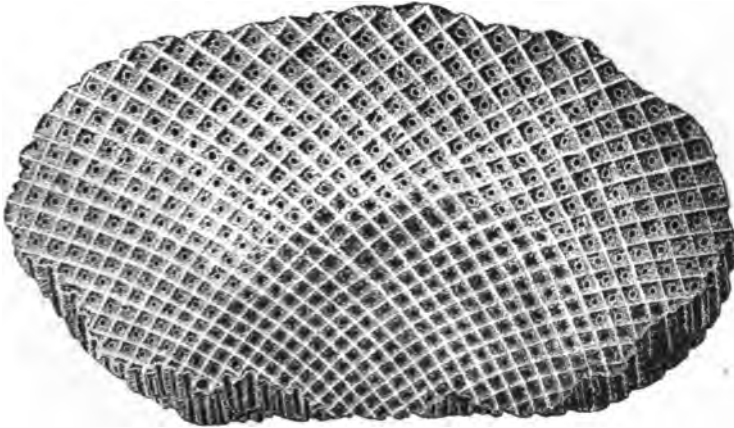
Fig. 4. Longitudinal section, enlarged.

*INDEMNITATE MONTANA* *Eol.*

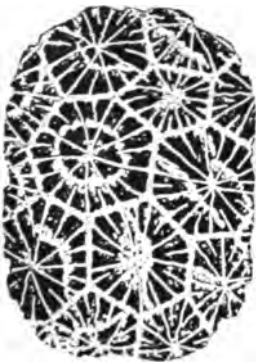
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Fig. 5. Lateral view of a group.

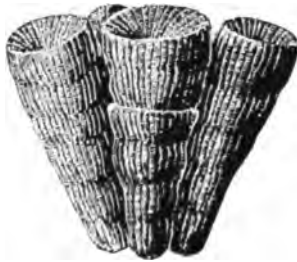
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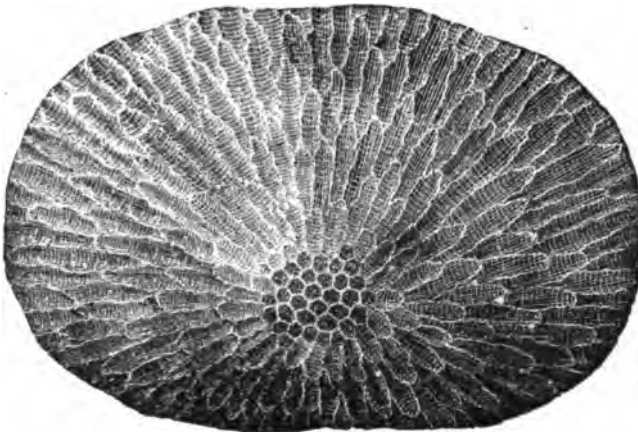
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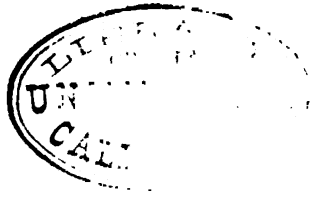


PLATE 2.

HELIOLITES INTERSTINCTUS, *Linne.*

Page 252.

- Fig. 1. Upper view of a specimen, natural size.
- Fig. 2. Oblique view of a specimen, showing the upper surface and the vertical section.
- Fig. 3. Upper surface, enlarged.

LYELLIA AMERICANA, *Edwards & Haime.*

Page 252.

- Fig. 4. Upper surface, enlarged.
- Fig. 5. Vertical section enlarged. This section does not cut the cell tubes, and only represents the intercellular tissue.

THECIA MAJOR, *Rominger.*

Page 253.

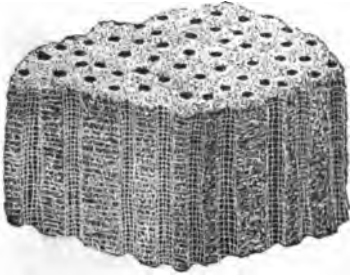
- Fig. 6. Upper view of a specimen.

FAVOSITES VENUSTUS, *Hall.*

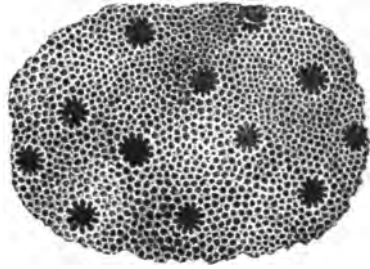
Page 253.

- Fig. 7. Oblique view of a specimen with the upper surface removed, showing the form of the cell tubes, and the vertical section showing the transverse diaphragms.
- Fig. 8. Upper view of a slightly weathered specimen.

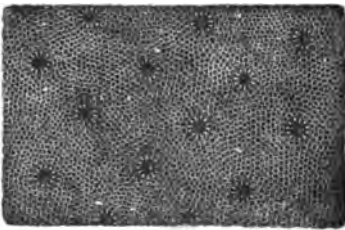
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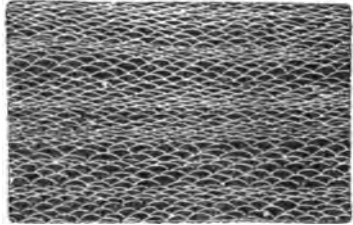
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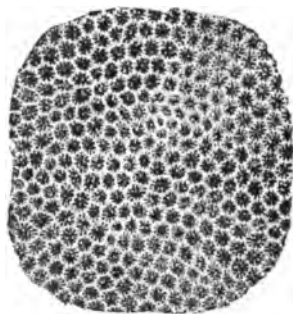
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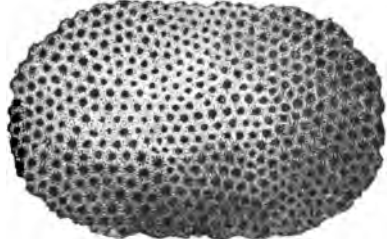
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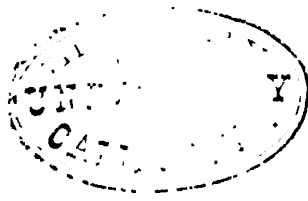




PLATE 3.

FAVOSITES FAVOSUS, *Goldfuss*.

Page 253.

- Fig. 1. Upper view of a specimen.
- Fig. 2. Lateral view.
- Fig. 3. Lateral view, enlarged, showing the position of the pores.
- Fig. 4. Transverse section, enlarged, showing the number and position of the pores.

SYRINGOPORA VERTICILLATA, *Goldfuss*.

Page 254.

- Fig. 5. Side view of a mass of corallites. The figure of this species by Mr. Van Cleve does not correspond with the figure of Goldfuss, nor with specimens identified as *S. verticillata*, from the Niagara group in the Western States.

ERIDOPHYLLUM RUGOSUM, *Edwards & Haime*.

Page 255.

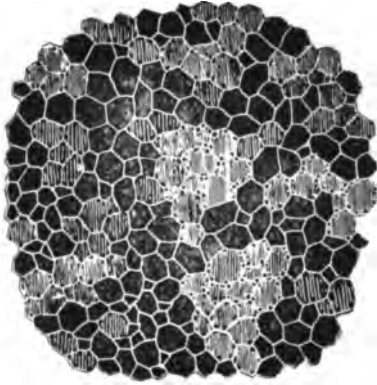
- Fig. 6. Lateral view, showing the constrictions and processes of the tubes.

LYELLIA AMERICANA, *Edwards & Haime*.

Page 252.

- Fig. 7. Lateral view of a weathered specimen, showing the furrowed tubes.

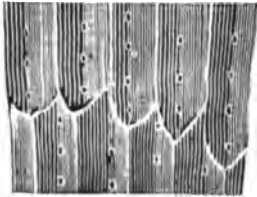
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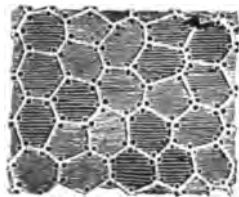
2



3



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5



6



7







PLATE 4.

AULOPORA VANCEVII, *Hall.*

Page 255.

- Fig. 1. A large colony, showing the compact and scattered forms of growth.  
Fig. 2. Several of the tubes enlarged.

FAVOSITES EMMONSI, *Rominger.*

Page 256.

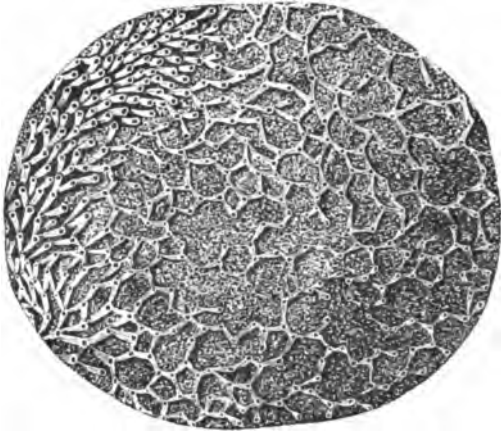
- Fig. 3. Upper surface of a specimen.  
Fig. 4. Side view enlarged, showing the transverse diaphragms and the pores.

FAVOSITES LIMITARIS, *Rominger.*

Page 256.

- Fig. 5. A specimen with large branches, but slightly diverging.  
Fig. 6. A more slender and frequently branching form.

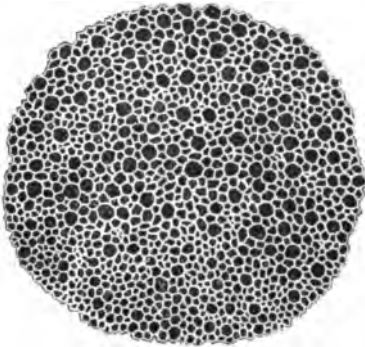
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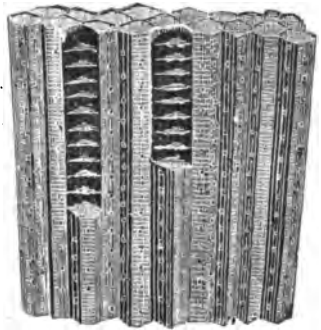
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and the







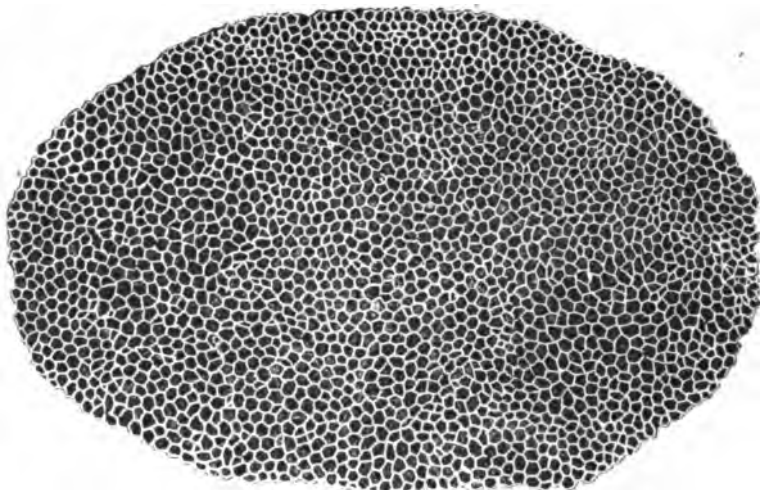
PLATE 5.

FAVOSITES HEMISPHERICUS, *Yandell & Shumard.*

Page 257.

- Fig. 1. Upper view of a corallum, showing the size and form of the corallites.  
Fig. 2. Lower surface with the epitheca removed, showing the septate tubes of the corallites.

1



2

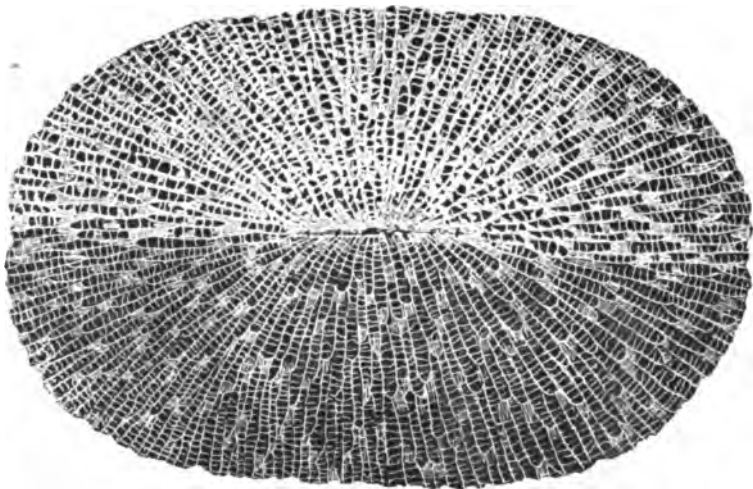






PLATE 6.

HELIOPHYLLUM HALLI, *Edwards & Haime.*

Page 259.

Fig. 1. Lateral view of an unusually large and fine specimen.

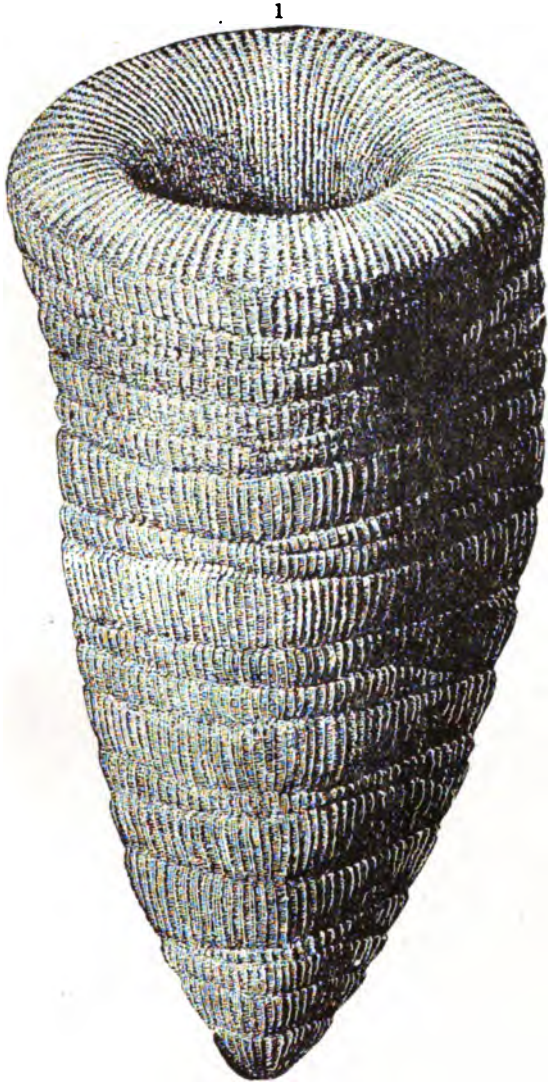








PLATE 7.

SYRINGOPORA PERELEGANS. *Billings.*

Page 258.

Fig. 1. Lateral view of a mass of corallites.

HELIOPHYLLUM COALITUM. *Reminger.*

Page 259.

Fig. 2. Lateral view of a single specimen. There may be some doubt as to the identity of this form with Fig. 3.

Fig. 3. Upper view of compound group.

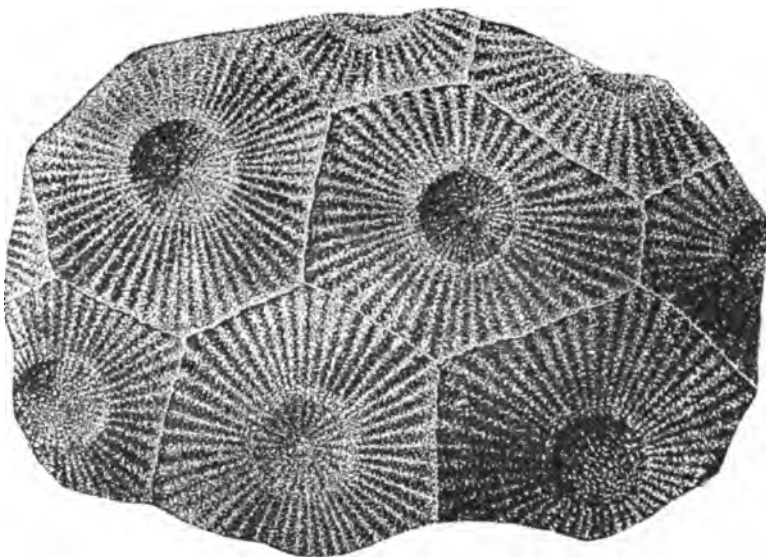
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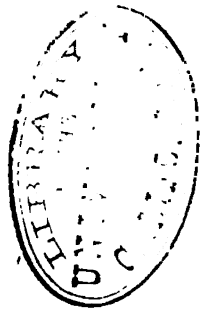




PLATE 3.

CYATHOPHYLLEUM RUGOSUM? *Hall.*

Page 250.

- Fig. 1. Upper side of a colony showing the corallites. The figure is identified with considerable doubt. Mr. Van Cleave's description agrees with the species better than the characters represented in the figure.
- Fig. 2. Lower surface showing the concentric lines of the epitheca and the radiation of the interior structure.

ERIDOPHYLLEUM VERNICILLANUM? *Edwards & Haine.*

Page 251.

- Fig. 3. Lateral view of a specimen showing the lateral processes. The figure does not correspond in all features to typical specimens of this species. The corallites are smaller than usual, and the lateral processes more regular. It must be remembered that some of these illustrations are composite in their representation, owing to embodying the characters of several specimens in one figure, and to the evident attempt to follow Goldfuss, both in descriptive characters and in illustration.

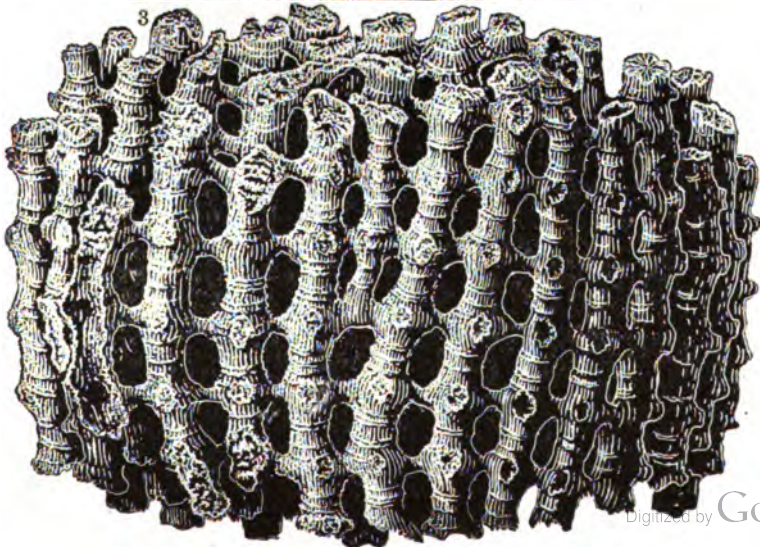
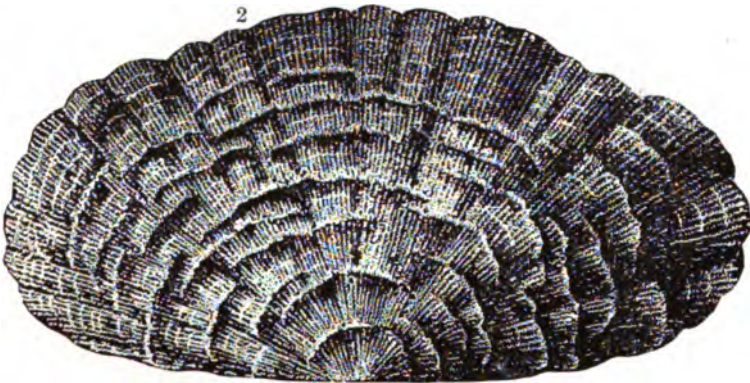
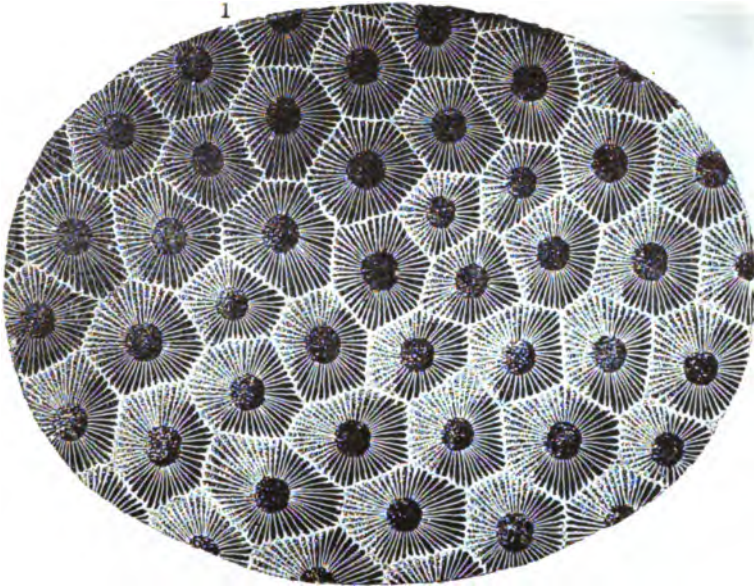








PLATE 9.

ERIDOPHYLLUM SIMCOENSE, *Billings*.

Page 262.

Fig. 1. Lateral view of a group of corallites.

DIPHYPHYLLUM STRAMINEUM, *Billings*.

Page 261.

Fig. 2. Side view of a specimen.

CYSTIPHYLLUM PUSTULATUM, *Hall*.

Page 262.

Fig. 3. Lateral view of a corallum, showing its size and the turbinate form.

Fig. 4. Transverse section. (These sections are referred, with doubt, to this species.)

Fig. 5. A longitudinal section of a corallum.

1



2



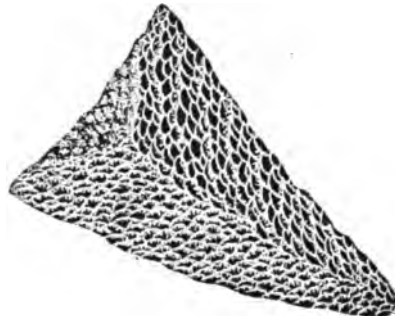
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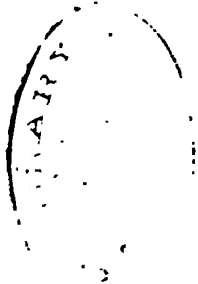




PLATE 10.

MONTICULIPORA GRACILIS, *James.*

Page 248.

- Fig. 1. Fragment of a corallum.
- Fig. 2. Fragment of another example.
- Fig. 3. The termination of a branch, enlarged.

MONTICULIPORA DISCOIDEA, *James.*

Page 247.

- Fig. 4. Basal views of three specimens.
- Fig. 5. Upper side of a specimen, enlarged.

MONTICULIPORA TUBERCULATA, *Edwards & Haime.*

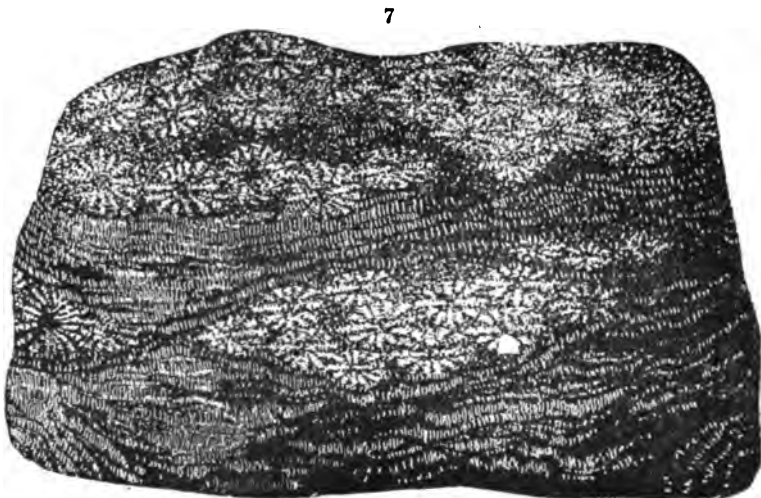
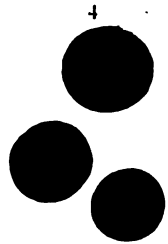
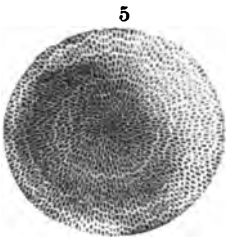
Page 251.

- Fig. 6. A specimen attached to a portion of an *Orthoceras*, natural size.

STROMATOPORA (SYRINGOSTROMA) DENSUM, *Nicholson.*

Page 263.

- Fig. 7. Oblique view of a specimen, showing the star-like canals of the upper surface, and the vertical structure of the mass.





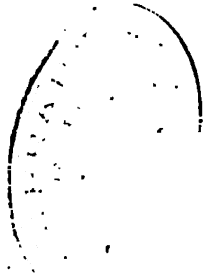




PLATE 11.

MONTICULIPORA MAMMULATA, *D'Orbigny.*

Page 250.

Fig. 1. A fragment of a corallum.

MONTICULIPORA DALII, *Edwards & Haime.*

Page 249.

Fig. 2. A fragment showing the method of branching, and the number and arrangement of the elevations on the surface.

MONTICULIPORA—*species?*

Page —.

Fig. 3. A fragment of undetermined specific relations.

Fig. 4. " " " " " "

Fig. 5. " " " " " "

Fig. 7. " " " " " "

Fig. 12. " " " " " "

Fig. 13. " " " " " " (enlarged.)

MONTICULIPORA APPROXIMATA, *Nicholson.*

Page 250.

Fig. 6. A fragment of a corallum.

MONTICULIPORA JAMESI, *Nicholson.*

Page 248.

Fig. 8. A small fragment referred to this species.

MONTICULIPORA ANDREWSI, *Nicholson.*

Page 249.

Fig. 9. A portion of a corallum.

MONTICULIPORA ULRICHI, *Nicholson.*

Page 249.

Fig. 10. A small fragment of a corallum.

MONTICULIPORA GRACILIS, *James.*

Page 248.

Fig. 11. A single branch of a corallum.

N. B. The species on this plate were identified through the kindness of S. A. Miller, Esq., of Cincinnati, Ohio.

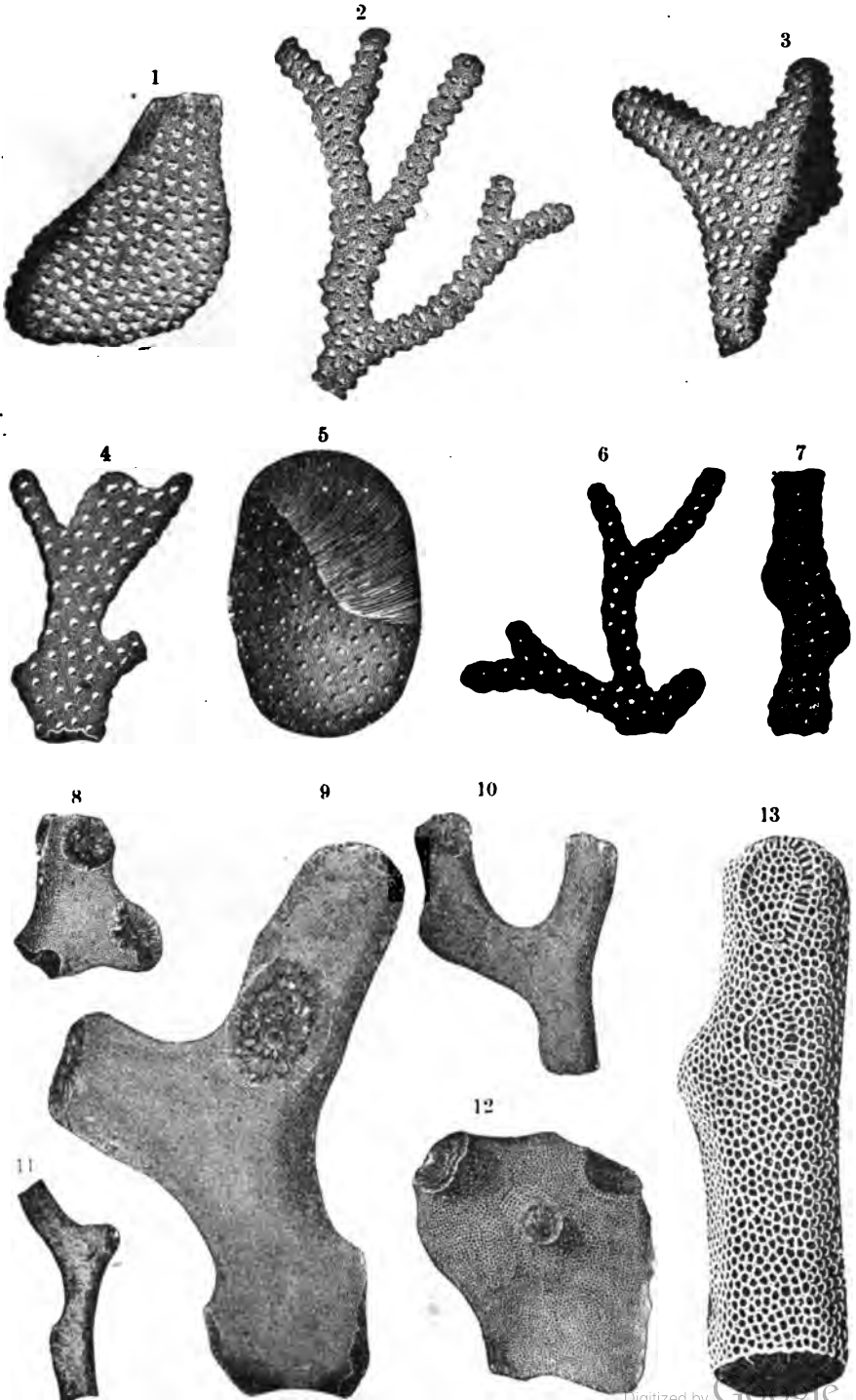






PLATE 12.

PTILODICTYA FALCIFORMIS, *Nicholson.*

Page 265.

Fig. 1. A frond of this species, natural size.

PTILODICTYA EXPANSA, *Hall and Whitfield.*

Page 266.

Fig. 2. A specimen showing portions of four fronds, two of which show their terminations.

Fig. 3. A portion, enlarged.

1



2



3

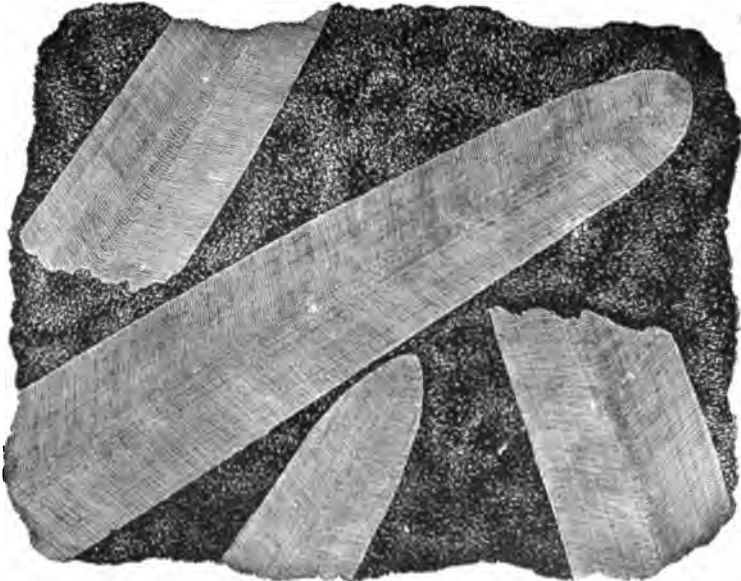








PLATE 13.

STICTOPORA VANCELVII, *Hall.*

Page 268.

- Fig. 1. A specimen preserving portions of two fronds showing their size and mode of branching.  
Fig. 2. A portion enlarged.

STICTOPORA BIFURCATA, *Van Cleve.*

Page 267.

- Fig. 3. A specimen showing two bifurcations.  
Fig. 4. A fragment of the frond, enlarged. (The arrangement of the pores at the bifurcation in this figure and in figure 2 is not strictly accurate.)

PTILODICTYA BIPUNCTATA, *Van Cleve.*

Page 266.

- Fig. 5. A specimen with three entire fronds, showing a gradation from the elongate form at the upper left hand corner to the large, broad-lobed specimen.

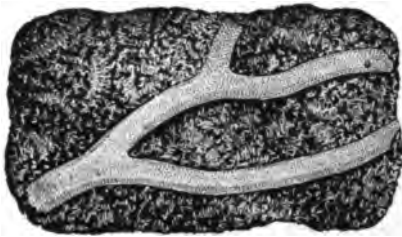
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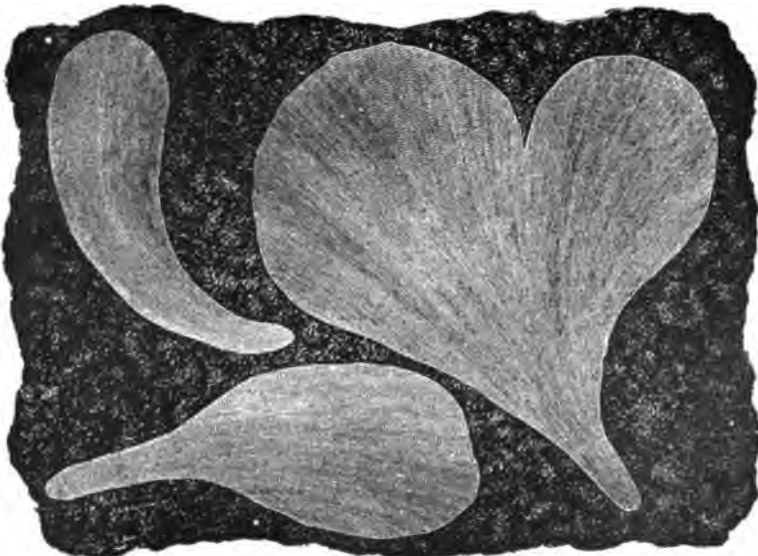






PLATE 14.

RETEPORA ANGULATA, *Hall.*

Page 269.

- Fig. 1. A portion of a frond.  
Fig. 2. A fragment, enlarged.

STICTOPORA COMPRESSA, *Van Cleve.*

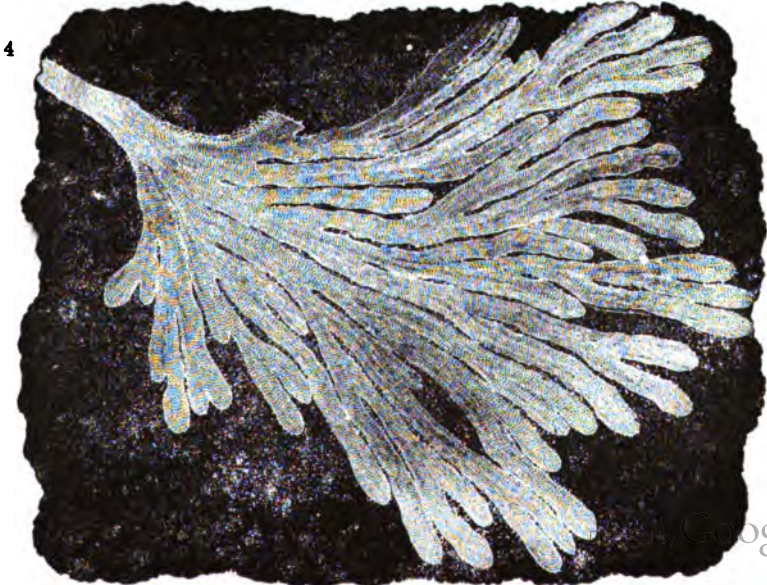
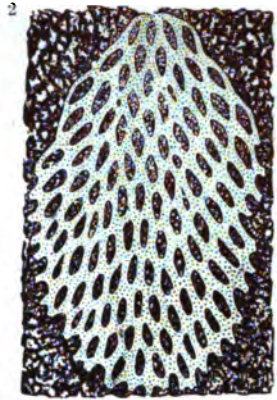
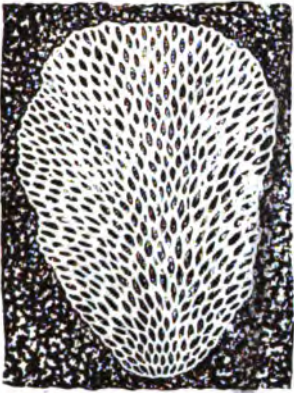
Page 267.

- Fig. 3. A portion of a frond showing the manner of growth and the size of the branches.

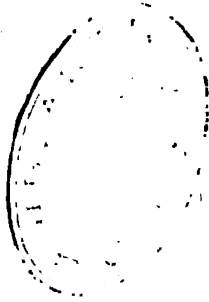
STICTOPORA MULTIFIDA, *Van Cleve.*

Page 268.

- Fig. 4. A large and apparently nearly entire frond, exhibiting the close and frequent branching and the longitudinal arrangement of the pores.









EXPLANATION OF PLATES.

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PLATE 15.

CHONOPHYLLUM VADUM.

Page 272.

- Fig. 1, 2. Lateral views of individuals of the ordinary form.  
Fig. 3. View of the calyx of fig. 2.  
Fig. 4. An individual showing proliferous growth.

ANISOPHYLLUM UNILARGUM.

Page 272.

- Fig. 5. Lateral view of specimen of ordinary size and proportions.  
Fig. 6. An imperfect specimen, showing the single prominent ray in the anterior side of the calyx.

ANISOPHYLLUM TRIFURCATUM.

Page 273.

- Fig. 7, 8. Lateral and posterior views of different specimens. The stronger lamellæ are not well shown in fig. 8.

CYATHOPHYLLUM INTERTRIUM.

Page 273.

- Fig. 9, 10. Lateral and summit views of a specimen.  
Fig. 11. An enlargement, showing the three finer rays between the stronger ones

CYSTIPHYLLUM GRANILINEATUM.

Page 274.

- Fig. 13. Lateral view of an imperfect specimen. (For view of the calyx, see pl. 23, fig. 13.)

HELIOPHYLLUM PRAVUM.

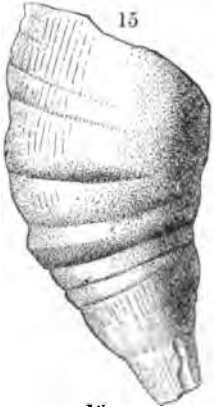
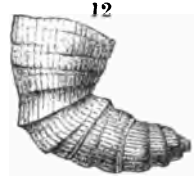
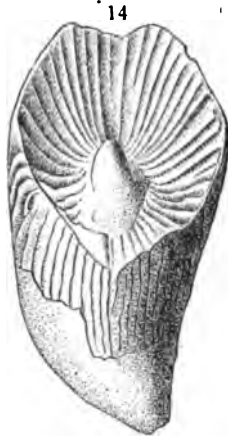
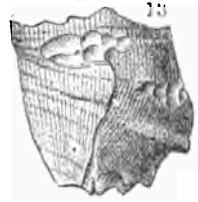
Page 274.

- Fig. 12. Lateral view of a specimen of ordinary size and form.  
(For view of the calyx, see plate 25, fig. 4.)

CYATHAXONIA HERZERI.

Page 275.

- Fig. 14. Posterior view of a specimen, showing interior of the calyx.



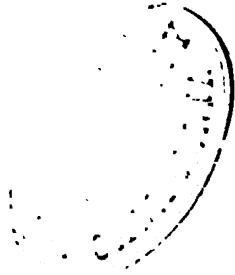


PLATE 15—Continued.

*STREPTELASMA COARCTATUM.*

Page 276.

Figs. 15, 16. Lateral and posterior views of a specimen; the latter showing the interior of the calyx with the twisted lamellæ.

*STREPTELASMA INFLATUM.*

Page 276.

Fig. 17. Lateral view of a specimen of the ordinary proportions.  
Fig. 18. The calical view of the specimen fig. 17.

*ZAPHRENTIS CYATHIFORMIS.*

Page 290.

Fig. 19. Lateral view of a specimen.  
(For calicular view, see plate 16, fig. 4.)

*STREPTELASMA PAPILLATUM.*

Page 276.

Fig. 20. Lateral view of a specimen of ordinary proportions.

PLATE 16.

STREPTELASMA SIMPLEX.

Page 277.

Fig. 1. Lateral view of an individual of ordinary size.

STREPTELASMA MAMMIFERUM.

Page 278.

Fig. 2. Specimen somewhat worn, with the lamellæ broken.

Fig. 3. Specimen nearly entire, preserving the conical elevation in the center.  
(See plate 21, figs. 1 and 2.)

ZAPHRENTIS CYATHIFORMIS.

Page 290.

Fig. 4. View of a calyx. (See plate 15, fig. 19.)

AULACOPHYLLUM TRISULCATUM.

Page 279.

Fig. 5. View of a calyx.

AULACOPHYLLUM PRÆCIPITUM.

Page 280.

Fig. 6. Lateral view of the coral.

Fig. 7. Interior of calyx.

AULACOPHYLLUM PRINCEPS.

Page 281.

Fig. 8. View from the posterior side, showing the interior of the calyx and lamellæ.

Fig. 9. Lateral view of the same individual.

Fig. 10. Posterior view of the same individual.

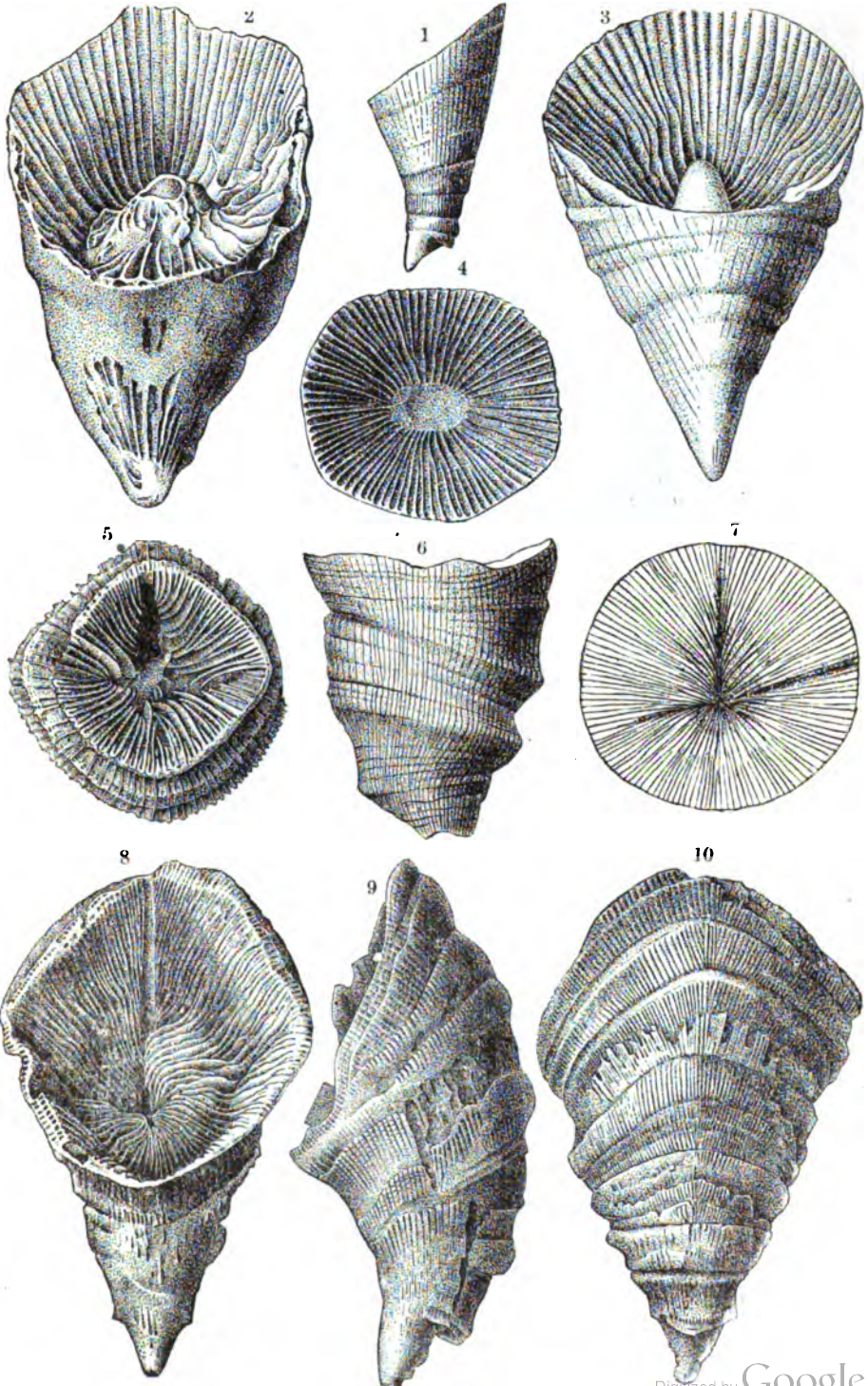








PLATE 17.

*AULACOPHYLLUM CONVERGENS.*

Page 281.

- Fig. 1. Lateral view of the coral.
- Fig. 2. View of the calyx.

*AULACOPHYLLUM PRATERIFORME.*

Page 282.

- Fig. 3. Lateral view of an imperfect specimen.
- Fig. 4. Calyx of the same.

*AULACOPHYLLUM CRUCIFORME.*

Page 283.

- Fig. 5. Lateral view of the coral.
- Fig. 6. Anterior view, showing the calyx.

*AULACOPHYLLUM SULCATUM.*

Page 279.

- Fig. 7. Posterior view of a worn specimen, showing the calyx.
- Fig. 8. A similar form to the preceding, but presenting variations in the fasciculating of the lamellæ.
- Fig. 9. Lateral view of a decorticated specimen.
- Fig. 10. Anterior view of same, showing calyx.

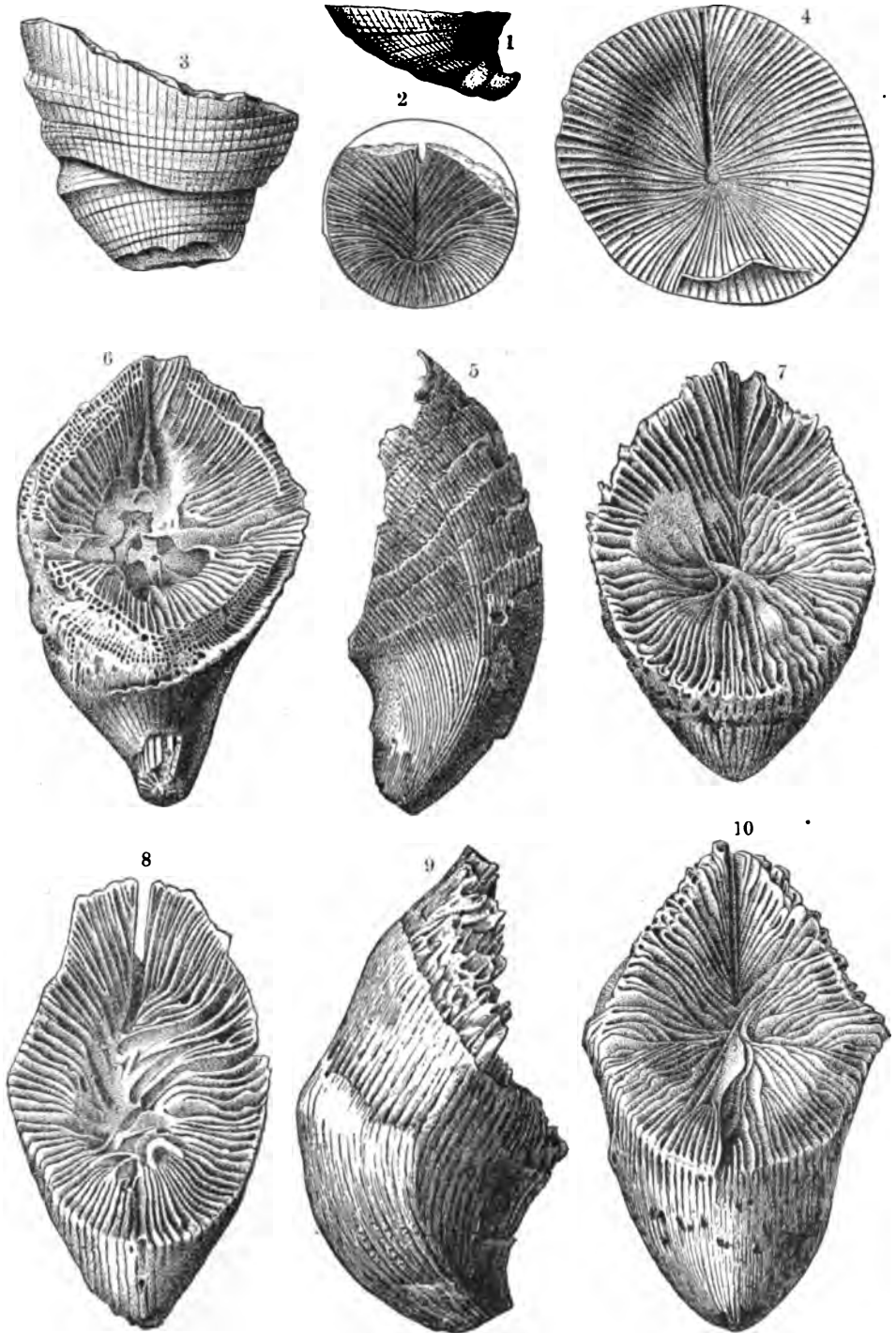






PLATE 13.

AULACOPHYLLUM PINNATUM.

Page 284.

Fig. 1. Lateral view of an imperfect specimen. (See plate 22, fig. 10.)

AULACOPYLLUM POCULUM.

Page 283.

Fig. 2. Lateral view of the upper portion of a specimen.

Fig. 3. View of the calyx of the same.

Fig. 4. Outline showing the concavity of the calyx.

AULACOPHYLLUM RFLEXUM.

Page 284.

Fig. 5. Lateral view of a specimen.

Fig. 6. View of the calyx of the same.

Fig. 7. Outline showing concavity of the cup.

ZAPHRENTIS SUBCOMPRESSA.

Page 286.

Fig. 8. Lateral view of a specimen.

Fig. 9. The calyx of another specimen.

ZAPHRENTIS FOLIATA.

Page 286.

Fig. 10. Lateral view.

Fig. 11. A portion of the upper part showing the rays of the calyx on one side the other being broken away.

ZAPHRENTIS COLLETTI.

Page 315.

Fig. 12. View of the calyx showing the strong lamellæ.

Fig. 13. Lateral view of a specimen of the same species.

PTYCHOPHYLLUM KNAPPI.

Page 278.

Fig. 14. Lateral view of a short and broad specimen.

Fig. 15. Lateral view of a more elongate and irregular growing individual. (See plate 25, figs. 6 and 7.)

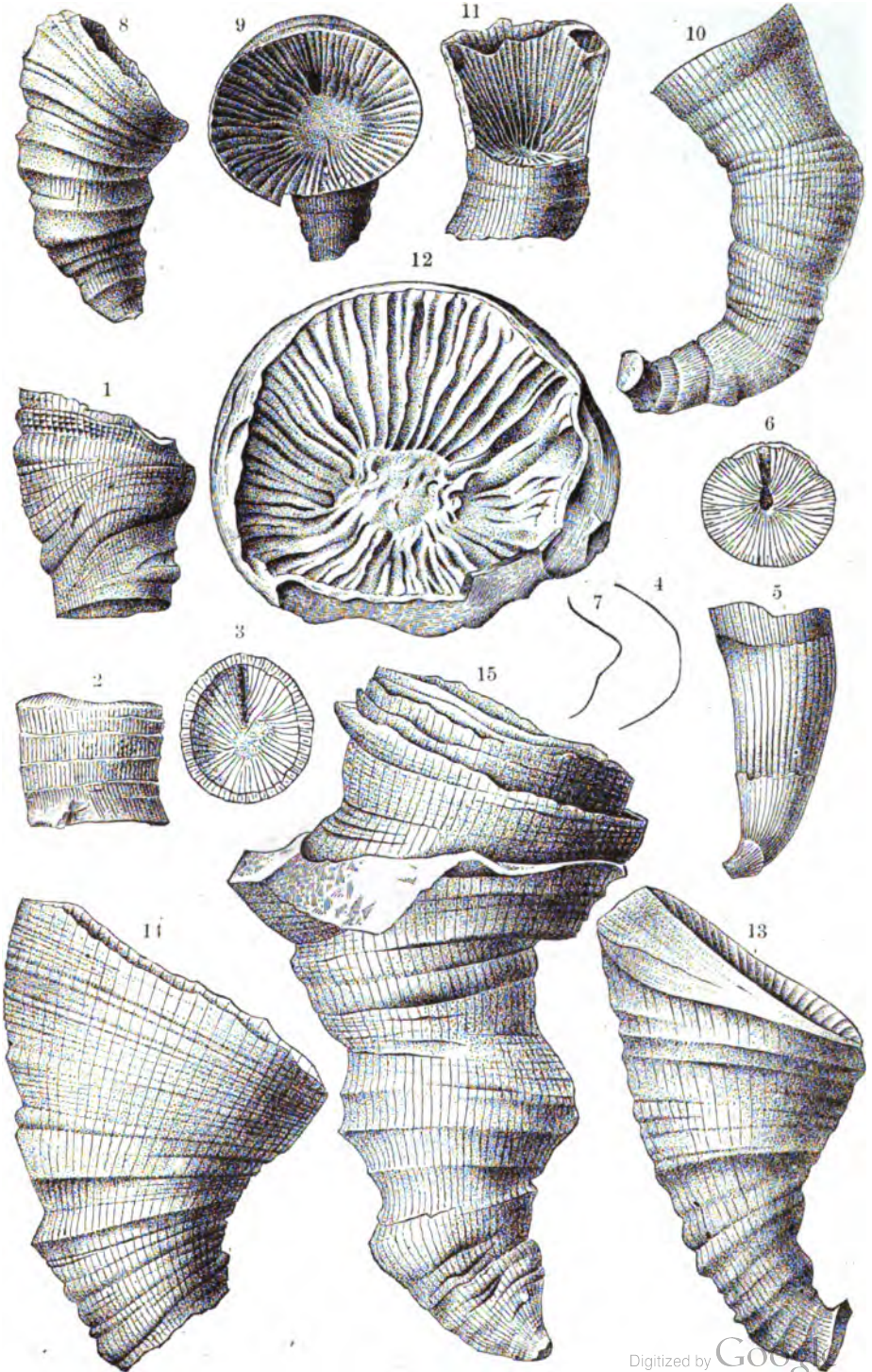








PLATE 19.

ZAPHRENTIS PROFUNDA.

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Fig. 1. Lateral view of a specimen.

ZAPHRENTIS ELEGANS.

Page 287.

Fig. 2. Posterior side, showing a portion of the calyx.

Fig. 3. View of the calyx of the same species from another specimen.

Figs. 4, 5. Lateral views of two specimens.

ZAPHRENTIS NITIDA.

Page 288.

Fig. 6. Lateral view. (See plate 20, figs. 4, 6.)

ZAPHRENTIS PONDEROSA.

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Fig. 7. A posterior view, looking into the calyx. The specimen is slightly twisted in its mode of growth.

ZAPHRENTIS SPISSA.

Page 289.

Fig. 8. Lateral view of an individual.

Fig. 9. The calyx of the same specimen.

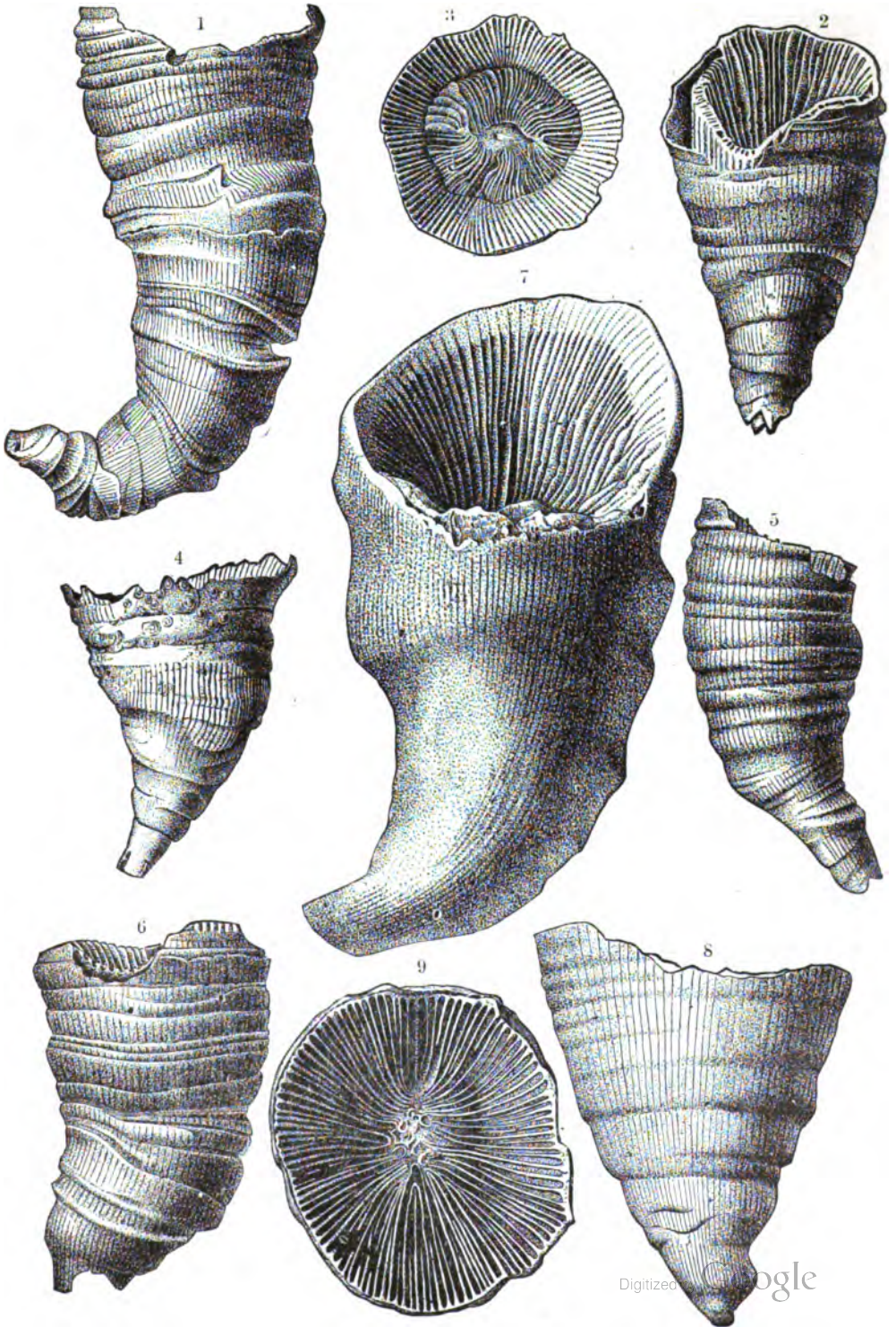






PLATE 20.

ZAPHRENTIS TRISUTURA.

Page 289.

- Fig. 1. The anterior side of a specimen.
- Fig. 2. Lateral view of left side of the same.
- Fig. 3. The calyx of the same.

ZAPHRENTIS NITIDA.

Page 288.

- Fig. 4. Lateral view of a specimen.
- Fig. 5. The calyx of the same.
- Fig. 6. The calyx of another individual. (See plate 19, fig. 6.)

ZAPHRENTIS UNDATA.

Page 291.

- Fig. 7. Lateral view of a small nearly erect form.
- Fig. 8. Lateral view of a larger individual, presenting the usual curved form.  
(See plate 25, fig. 1.)

ZAPHRENTIS DEFORMIS.

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- Fig. 9. Lateral view of a specimen.
- Fig. 10. The calyx of the same.



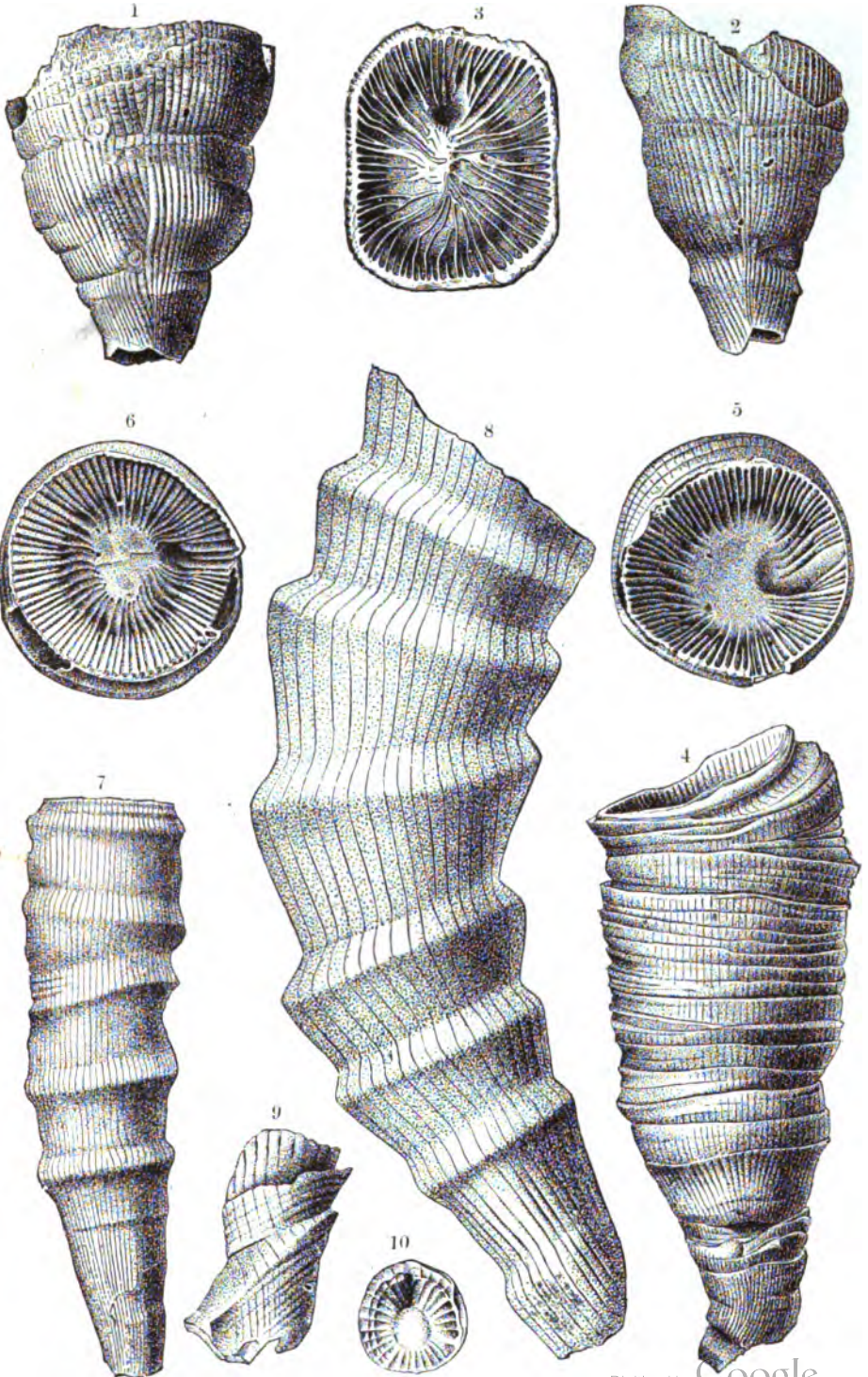








PLATE 21.

*STREPTALASMA MAMMIFERUM.*

Page 278.

- Fig. 1. View from the anterior side of a specimen, with the walls removed, showing the lamellæ with the central twisted elevation.  
Fig. 2. Anterior view of another individual, with the margin broken away, showing the interior with the central elevation.

*ZAPHRENTIS DUPLICATA.*

Page 293.

- Fig. 3. Posterior side of a specimen.

*ZAPHRENTIS COMPRESSA.*

Page 295.

- Fig. 4. Posterior side, looking into the calyx.  
Fig. 5. The calyx of the same specimen. (See plate 22, fig. 5.)

*ZAPHRENTIS CONCAVA.*

Page 291.

- Fig. 6. Lateral view.

*ZAPHRENTIS HERZERI.*

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- Fig. 7. Lateral view.  
Fig. 8. Anterior side of a specimen.  
Fig. 9. Posterior side.

*ZAPHRENTIS CALCARIFORMIS.*

Page 293.

- Fig. 10. Lateral view of a specimen.  
Fig. 11. The calyx of the same.

*ZAPHRENTIS FUSIFORMIS.*

Page 296.

- Fig. 12. Lateral view.  
Fig. 13. The calyx of the same.

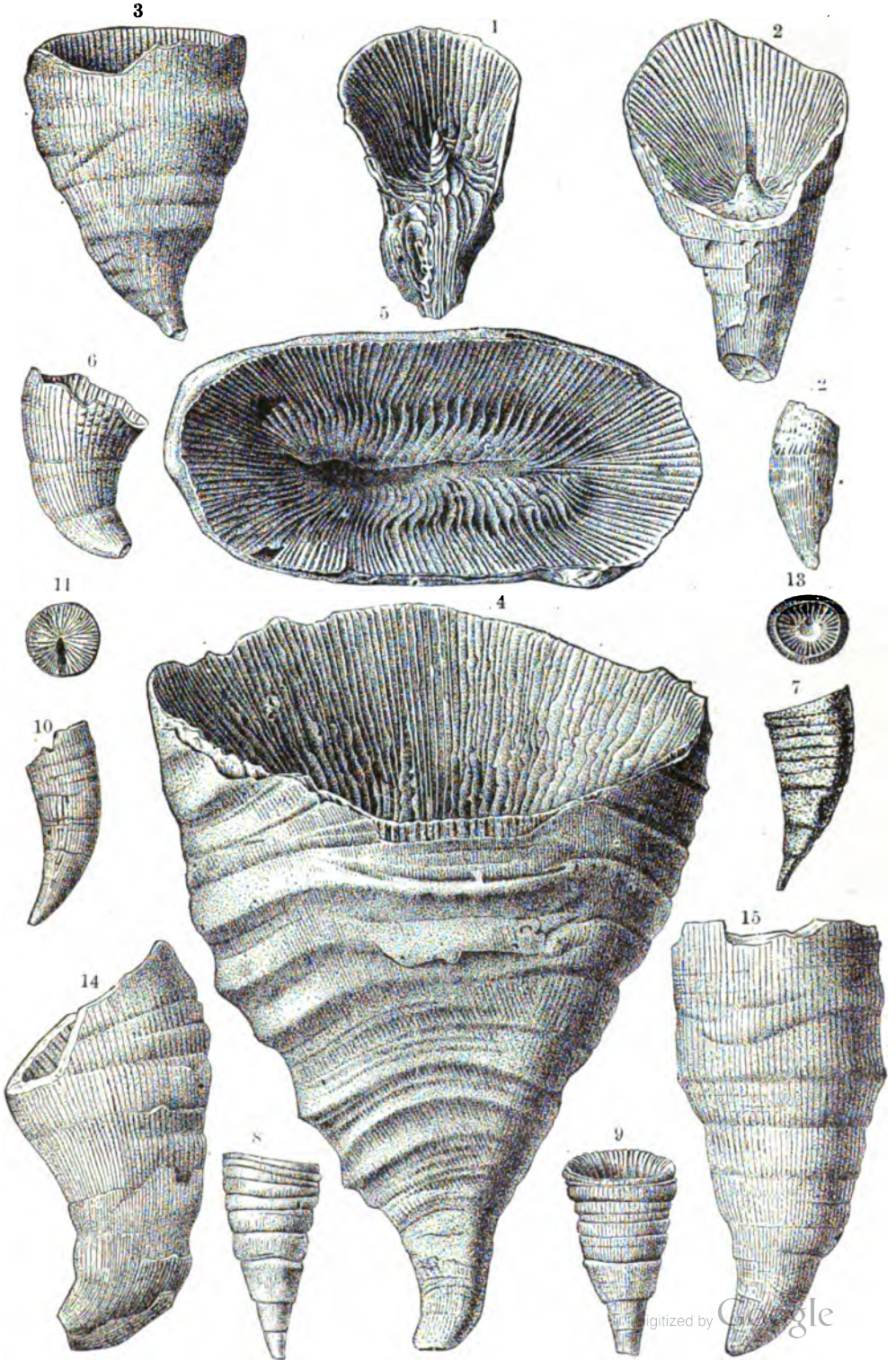




PLATE 21—Continued.

CYATHOPHYLLUM CONCENTRICUM.

Page 316.

Fig. 14. Lateral view of the coral.

ZAPHRENTIS PLANIMA.

Page 292.

Fig. 15. Lateral view of the coral.

PLATE 22.

ZAPHRENTIS TORTA.

Page 285.

Fig. 1. Lateral view of the coral.

ZAPHRENTIS CONVOLUTA.

Page 294.

Fig. 2. View from the posterior side, looking into the calyx.

CLISIOPHYLLUM CONIGERUM.

Page 299.

Fig. 3. Lateral view of a large individual.

Fig. 4. View of the posterior side of another specimen, showing the calyx with the central conical elevation.

ZAPHRENTIS COMPRESSA.

Page 295.

Fig. 5. Lateral view of the specimen. (Figs. 4, 5 of pl. 21.)

ZAPHRENTIS (AMPLEXUS?) CRUCIFORMIS.

Page 315.

Fig. 6. Lateral view of the coral.

Fig. 7. View showing the calyx; the wall on the posterior side is broken away.

AULACOPHYLLUM TRIPINNATUM.

Page 285.

Fig. 8. View of a specimen, imperfect at the base.

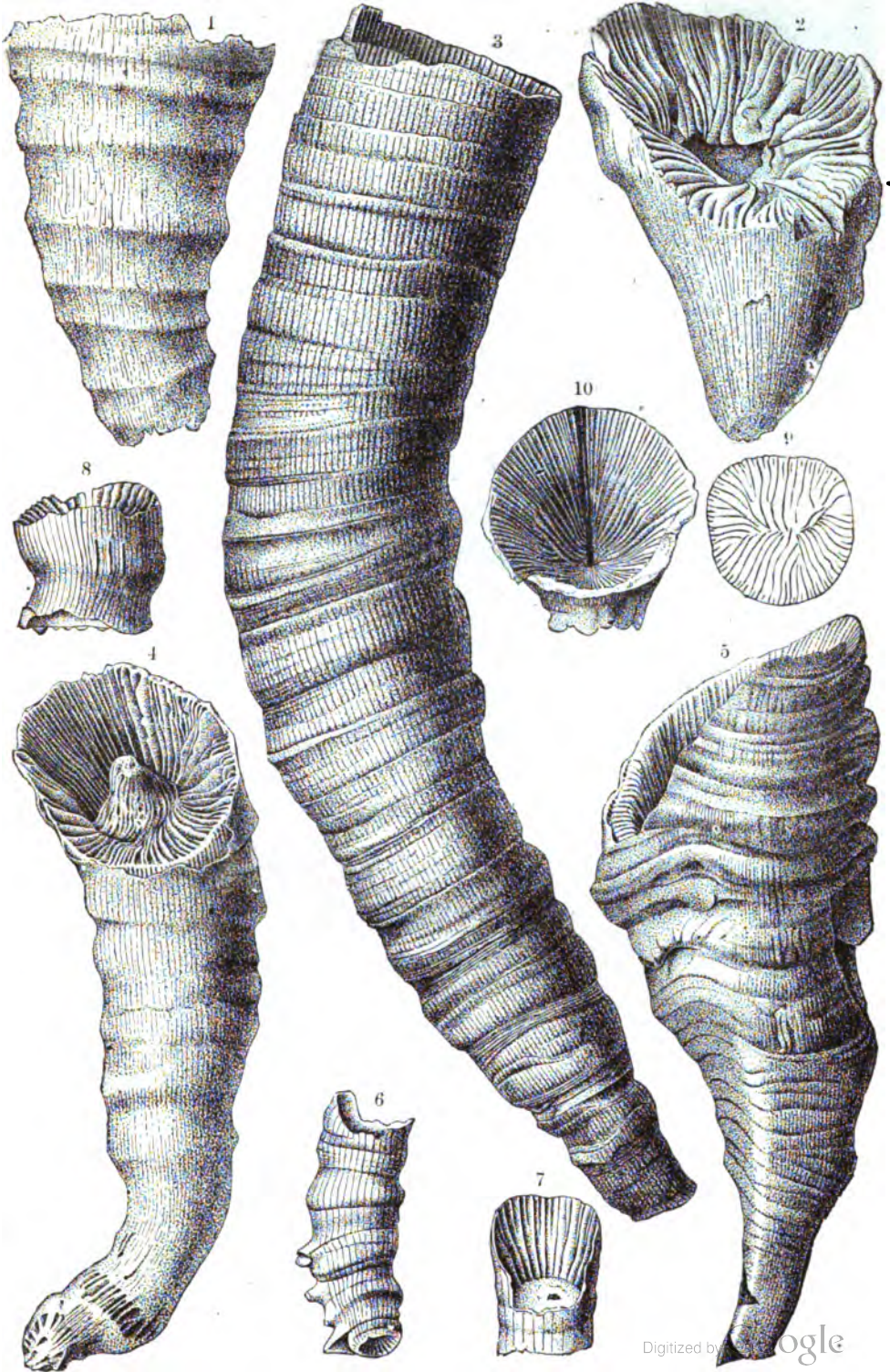
Fig. 9. Lateral view of the calyx.

AULACOPHYLLUM PINNATUM.

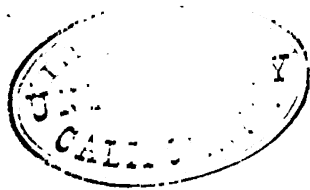
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Fig. 10. View from the posterior side looking into the calyx. (See plate 18, fig. 1.)











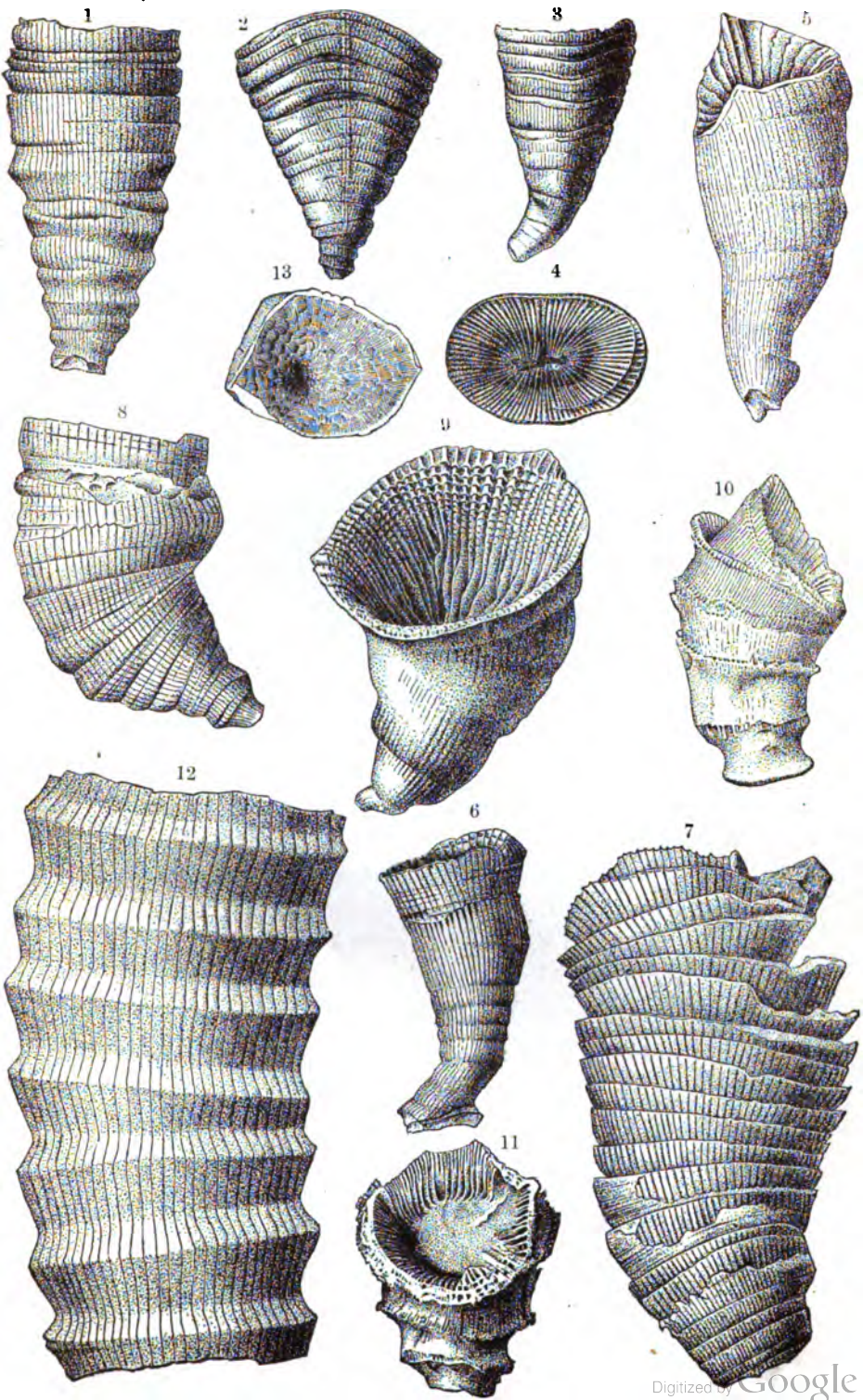
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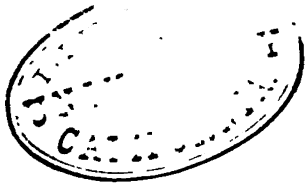


PLATE 23—Continued.

HELIOPHYLLUM ANNULATUM.

Page 307.

Fig. 12. A portion of the upper part of a large individual; lateral view. (See plate 25, figs. 2, 3.)

CYSTIPHYLLUM GRANILINEATUM.

Page 274.

Fig. 13. The calyx of the specimen figured on plate 15, fig. 13.

PLATE 24.

CYATHOPHYLLUM ARCTIFOSSA.

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- Fig. 1. Posterior side of the coral.  
Fig. 2. The calyx of the same.

CYATHOPHYLLUM DEPRESSUM.

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- Fig. 3. Lateral view of the coral.  
Fig. 4. Posterior side, looking into the calyx.

HELIOPHYLLUM ALTERNATUM.

Page 305.

- Fig. 5. Antero-lateral view of a specimen.  
Fig. 6. The calyx of the same.

HELIOPHYLLUM INFUNDIBULUM.

Page 305.

- Fig. 7. View from the posterior side, looking into the calyx. (See plate 23, fig. 8.)

COLEOPHYLLUM ROMINGERI.

Page 317.

- Fig. 8. Posterior side, looking into the calyx.  
Fig. 9. Lateral view of the same.

COLEOPHYLLUM PYRIFORME.

Page 318.

- Fig. 10. View of the posterior side, looking into the calyx. Compare with some forms of *cystiphyllum sulcatum*.

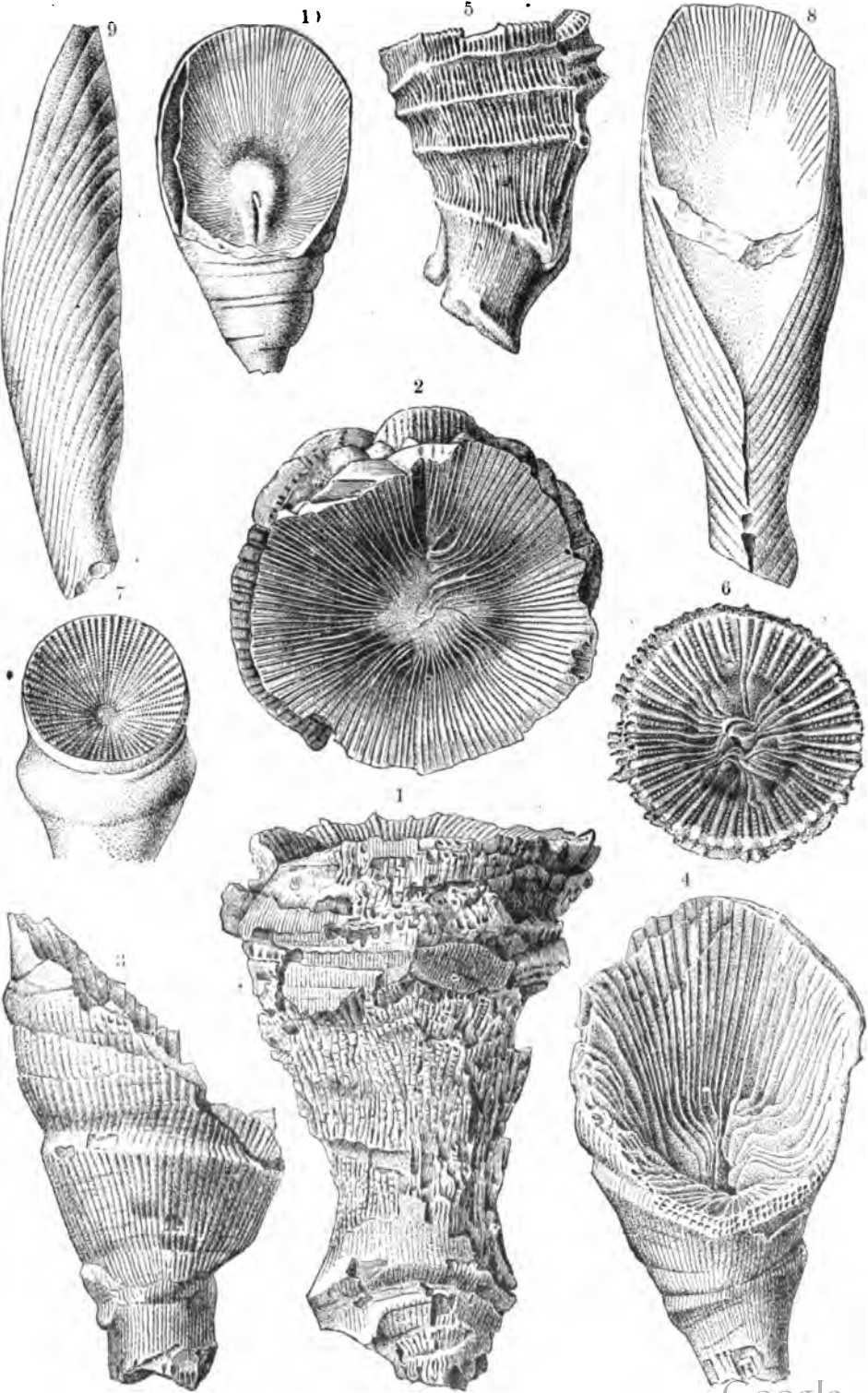








PLATE 25.

*MAPHRENTIS UNDATA.*

Page 291.

Fig. 1. Longitudinal section, showing the tabulae. See plate 20, figs. 7-9.

*HELLOPHYLLUM ANSULATUM.*

Page 297.

Fig. 2. Lateral view of a large specimen, imperfect at the base, showing the usual external characters.

Fig. 3. A longitudinal section of a straight specimen of this species. See plate 22, figs. 12, 13.

*HELLOPHYLLUM CRAVUM.*

Page 274.

Fig. 4. Oblique view, showing crivy. See plate 15, figs. 12, 13.

*HELLOPHYLLUM COMPACTUM.*

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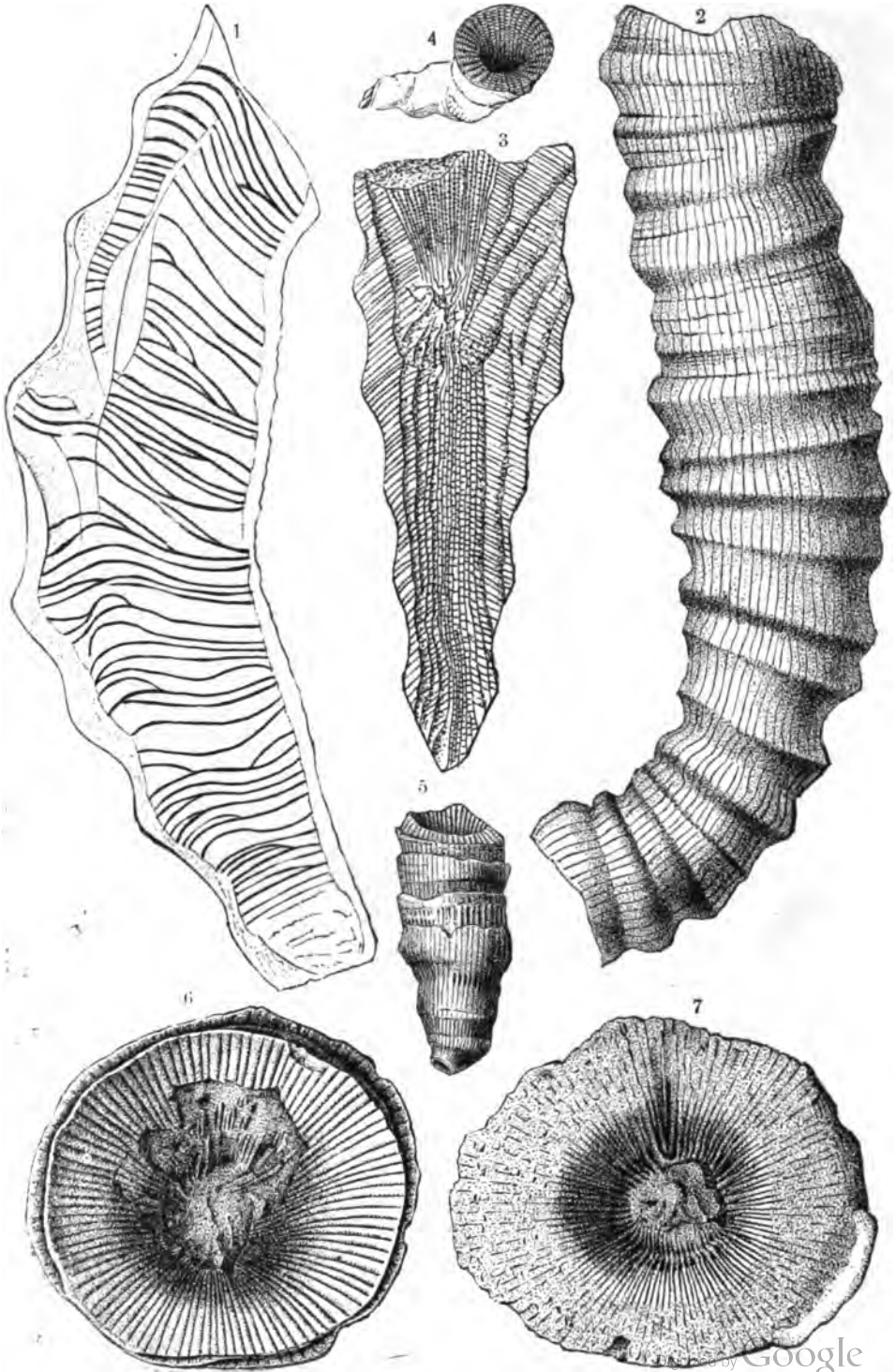
Fig. 5. Posterior side of the corall.

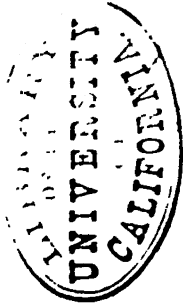
*HELLOPHYLLUM KNAPP.*

Page 278.

Fig. 6. A crivy showing the strong, coarse ribs.

Fig. 7. A crivy where the ribs are partially obliterated by calcification. See plate 18, figs. 14, 15.





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PLATE 26.

HELIOPHYLLUM DISTANS.

Page 308.

- Fig. 1. Lateral view of an individual.  
Fig. 2. The calyx of the same specimen.

HELIOPHYLLUM INCRASSATUM.

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- Fig. 3. Lateral view of an individual eroded from weathering.  
Fig. 4. The calyx of the same specimen.

HELIOPHYLLUM SCYPHULUS.

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- Fig. 5. Lateral view of a specimen. (See plate 28, figs. 2, 3.)

HELIOPHYLLUM FECUNDUM.

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- Fig. 6. Lateral view of parent coral with numerous buds. (See plate 27, figs. 4, 5.)

HELIOPHYLLUM DENTICULATUM.

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- Fig. 7. View of the calyx showing the strongly denticulate rays.

HELIOPHYLLUM NETTELROTHI.

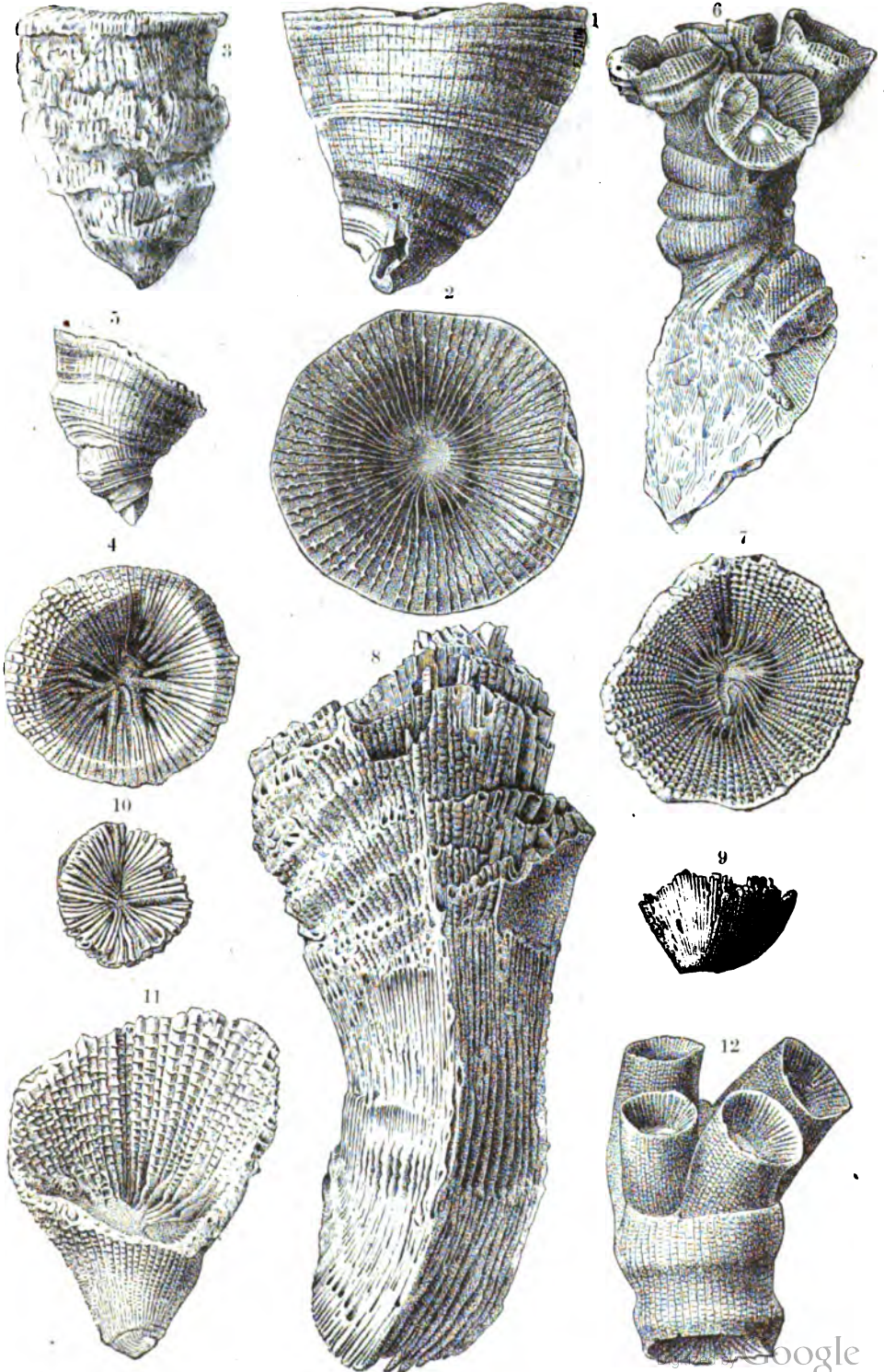
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- Fig. 8. Anterior side of a specimen, from which the epitheca has been removed.

HELIOPHYLLUM SORDIDUM.

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- Fig. 9. Lateral view of an imperfect specimen.  
Fig. 10. The calyx of the same.





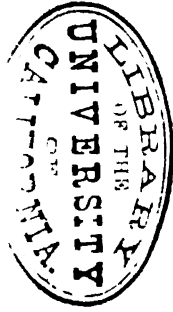


PLATE 26—Continued.

HELIOPHYLLUM ACUMINATUM.

Page 310.

Fig. 11. View from the posterior side, looking into the calyx.

HELIOPHYLLUM GEMMATUM.

Page 310.

Fig. 12. Lateral view, showing young corallites growing from the calyx of an older one.

PLATE 27.

HELIOPHYLLUM LATERICRESCENS.

Page 314.

Fig. 1. Lateral view of a group of corallites.

HELIOPHYLLUM TENUIMURALE.

Page 307.

Fig. 2. Lateral view of a specimen.

Fig. 3. The calyx of the same.

HELIOPHYLLUM FECUNDUM

Page 309.

Figs. 4, 5. Lateral and posterior views of a group of corallites. (See plate 26, fig. 6.)

DIPHYPHYLLUM APERTUM.

Page 303.

Fig. 6. Lateral view. (See plate 28, figs. 4, 5.)

DIPHYPHYLLUM ADNATUM.

Page 303.

Fig. 7. Lateral view.

Fig. 8. A calyx of one of the corallites.

BLOTHROPHYLLUM PROMISSUM.

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Fig. 9. A calyx of this species. (See plate 28, figs. 6, 7.)

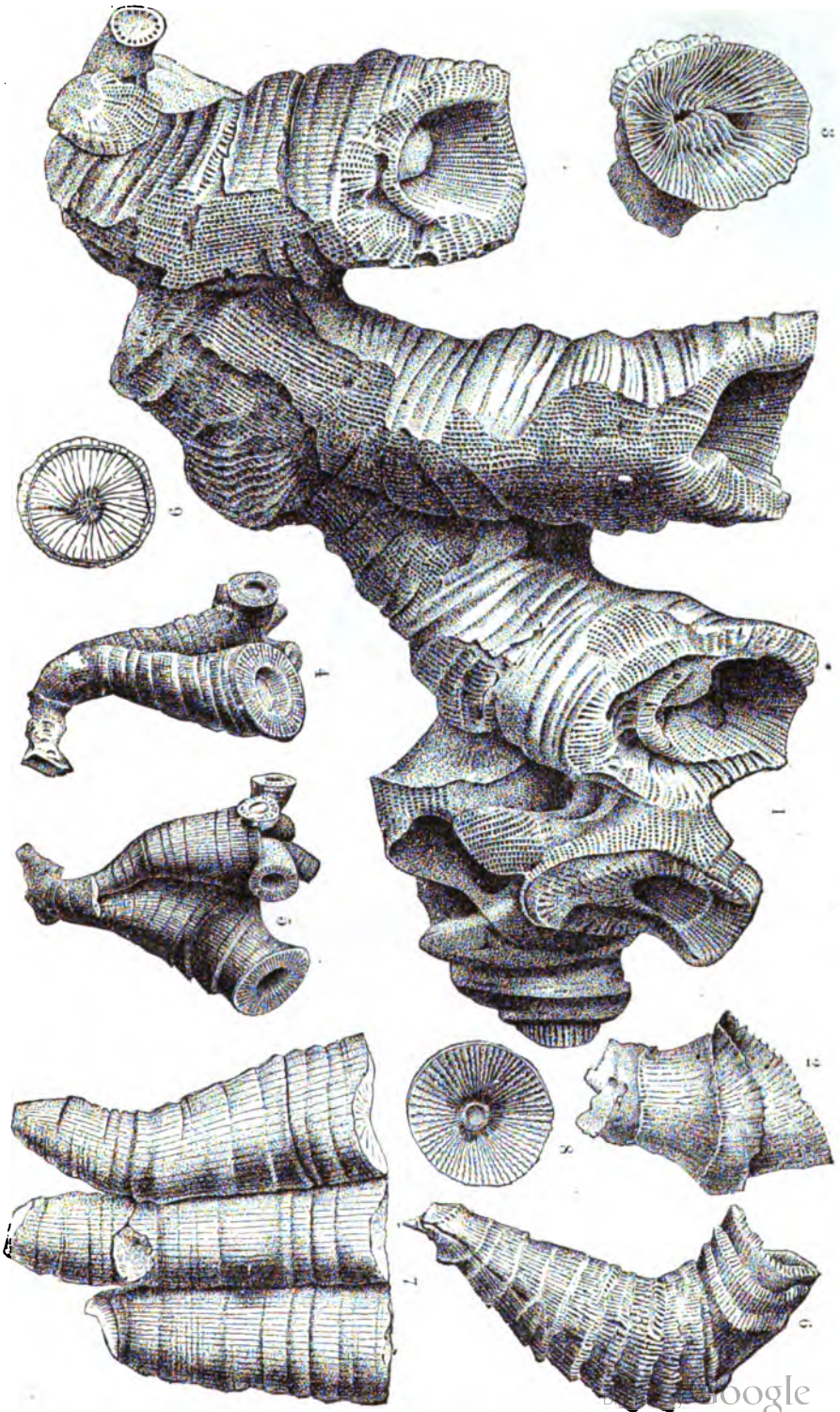






PLATE 28.

HELIOPHYLLUM INVAGINATUM.

Page 306.

Fig. 1. View from the posterior side looking into the calyx.

HELIOPHYLLUM SCYPHULUS.

Page 306.

Fig. 2. Lateral view. (See plate 26, fig. 5.)

Fig. 3. The calyx of the same species.

DIPHYPHYLLUM APERTUM.

Page 303.

Fig. 4. View from the posterior side looking into the calyx.

Fig. 5. The calyx of the same. (See plate 27, fig. 6.)

BLOTHROPHYLLUM PROMISSUM.

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Fig. 6. The axis of a decorticated specimen showing the invaginated character of the walls.

Fig. 7. A longitudinal section of another individual. (See plate 27, fig. 9.)

CYSTIPHYLLUM LATIRADIUM.

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Fig. 8. Lateral view.

Fig. 9. A calyx of the same.



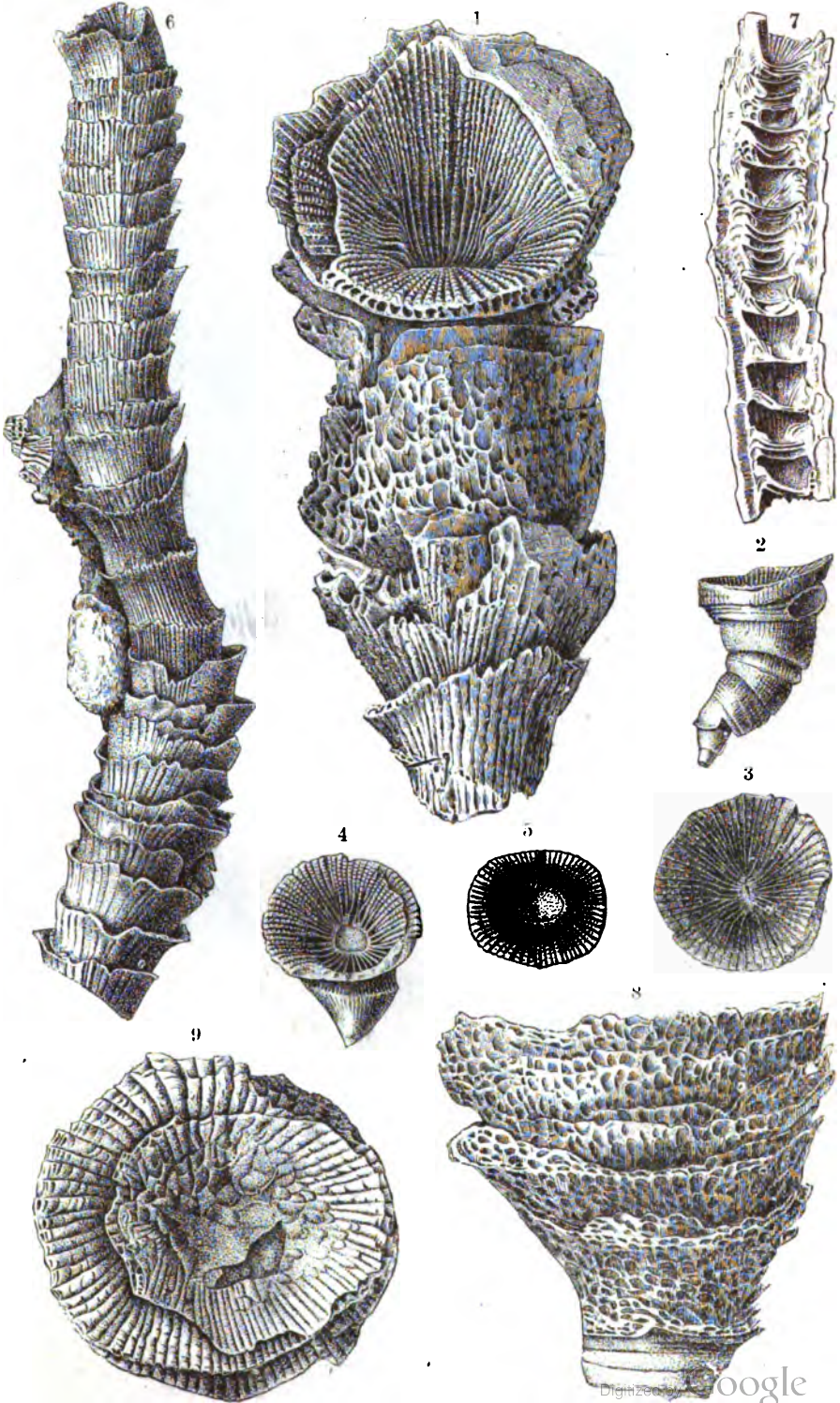








PLATE 29.

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Page 324.

- Figs. 1-5. Fig. 1, dorsal view of a ventricose specimen from Bloomington, Ind. Figs. 2-4, three views of a larger specimen from Spergen Hill, Ind. Fig. 5, interior of ventral valve of a large individual from Paynter's Hill, Ind.

PRODUCTUS INDIANENSIS.

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- Figs. 6-7. Profile and vertical views of the largest type specimen (2x).

PRODUCTUS BISERIATUS.

Page 325.

- Figs. 8-12. Fig. 8, enlarged (2x) view of interior of dorsal valve, from Bloomington. Fig. 9, another natural size from Alton, Ill. Figs. 10-12, three views of a large specimen from Spergen Hill, from later collections.

SPIRIFERA BIFURCATA.

Page 326.

- Figs. 13-15. Fig. 13, view of the original specimen (6x). Fig. 14, a larger individual (3x), and 15, a still larger one (2x) from Spergen Hill.

SPIRIFERINA NORWOODANA.

Page 327.

- Figs. 16-17. Dorsal and front views of one of the types (3x) from Alton, Ill.

ATHYRIS HIRSUTA.

Page 328.

- Figs. 18-21. Fig. 18, a small Spergen Hill specimen (2x), showing setæ; 19-21, three views of a larger specimen from later collections at the same locality.

ATHYRIS TRINUCLEUS.

Page 329.

- Figs. 22-27. Figs. 22 and 23, views of two specimens from Bloomington, showing variation of form; 24-27, views of a larger specimen more recently obtained from Spergen Hill.

EUMETRIA VERNEUILIANA.

Page 335.

- Figs. 28-30. Fig. 28, view of a specimen (2x) from Spergen Hill; fig. 29 is from a specimen more recently obtained from Paynter's Hill, Ind.; fig. 30, enlargement of hinge from one of the originals.

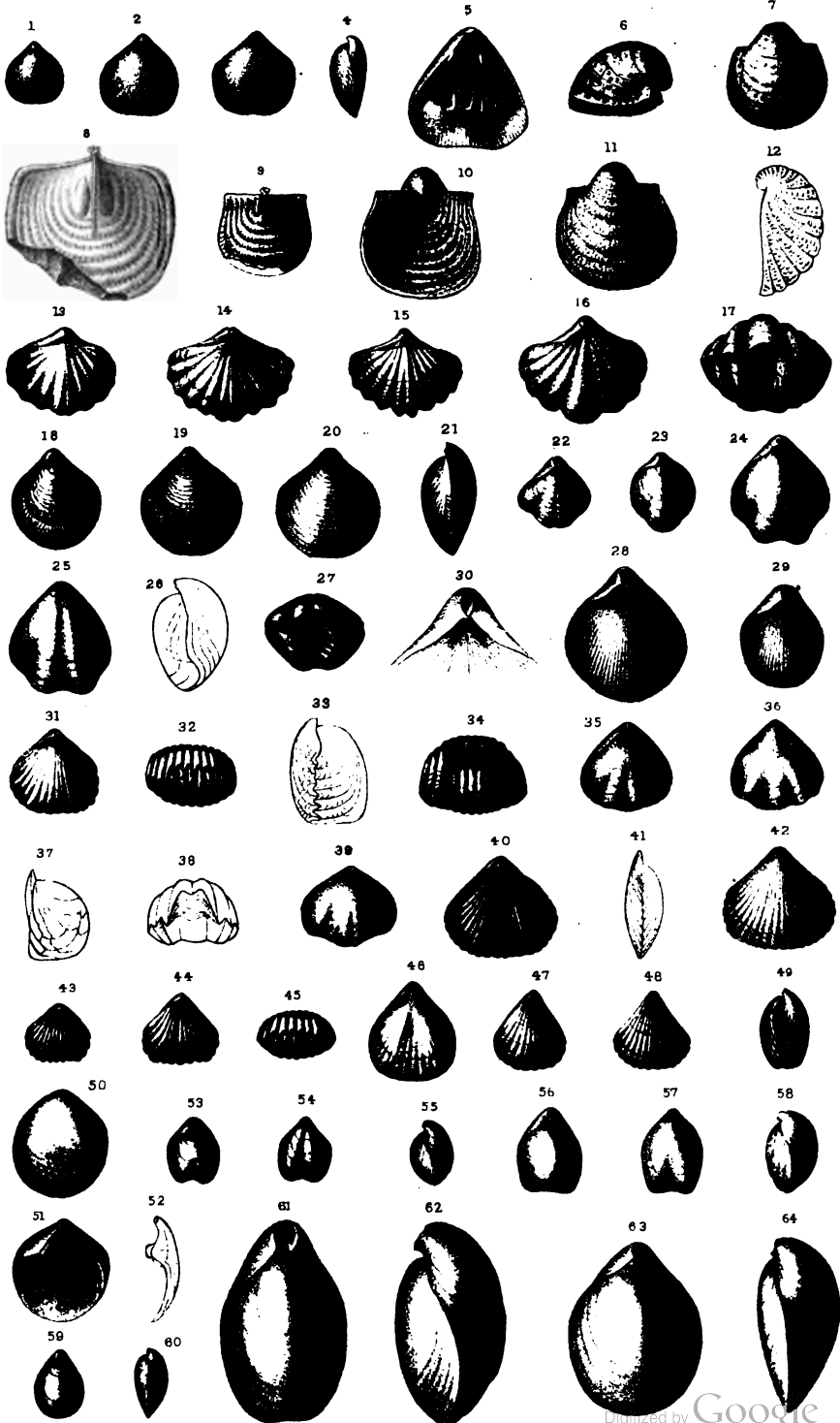
SPERGEN HILL FOSSILS.

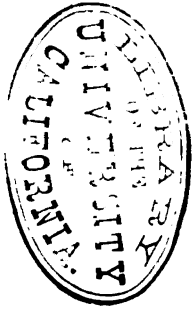
(Brachiopoda.)

ST. LOUIS GROUP.

PLATE 29.

Indiana Geol. Survey.





EXPLANATION OF PLATES.

PLATE 29—Continued.

RHYNCHONELLA GROSVENORI.

Page 331.

Figs. 31-34. Figs. 31 and 32, views (2x) of a large rotund specimen, 33 and 34, of a smaller one (3x), from Bloomington, Ind.

CAMAROPHORIA WORTHENI.

Page 334.

Figs. 35-39. Figs. 35-38, four views (2x) of the type specimen, showing strong plications, and 39, of one (2x) showing a different form of plication.

RHYNCHONELLA MACRA.

Page 334.

Figs. 40-42. Three views (2x) of a large specimen from Alton, Ill.

RHYNCHONELLA MUTATA.

Page 332.

Figs. 43-45. Fig. 43, dorsal view of a specimen of medium size; 44 and 45, dorsal and front views of a large one. Alton, Ill.

RHYNCHONELLA RICINULA.

Page 330.

Fig. 46. Dorsal view (6x) of one of the originals from Spergen Hill.

RHYNCHONELLA SUBCUNEATA.

Page 333.

Figs. 47-49. Dorsal, ventral and profile views of a specimen from Bloomington, Ind.

CENTRONELLA CRASSICARDINALIS, *Whitfield*.

Figs. 50-52. Exterior, interior and profile views of a separated ventral valve of a specimen from Spergen Hill, Ind.

TEREBRATULA TURGIDA.

Page 336.

Figs. 53-58. Figs. 53-55, three views of a specimen of medium size from Bloomington, Ind., and 56-58, similar views of a larger specimen from Ellettsville, Ind., from later collections.

TEREBRATULA FORMOSA.

Page 337.

Figs. 59-64. Figs. 59 and 60, two views of a small specimen from the original collection; figs. 61 to 64, similar views of larger specimens subsequently obtained. Spergen Hill, Ind.

PLATE 30.

PTERONITES SPERGENENSIS, *Whitfield.*

Fig. 1. View of a left valve of the species (2x) from Spergen Hill.

NUCULA SHUMARDANA.

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Figs. 2-6. Figs. 2 and 3, lateral and cardinal views (2x) of a specimen of normal form; figs. 4 and 5, lateral and dorsal views of a more elongate specimen (2x) from later collections; fig. 6, outline view, showing hinge (3x).

LEDA NASUTA.

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Figs. 7-9. Figs. 7 and 8, similar views (4x) of two original specimens; fig. 9, a view (3x) of a specimen subsequently obtained from Spergen Hill, Ind.

CYPRICARDINIA INDIANENSIS.

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Figs. 10-14. Fig. 10, cardinal view (4x) of a specimen from a later collection, showing both valves; fig. 11, end view, showing the inequality of the valves; fig. 12, view of the hinge (3x) as shown on a specimen from later collections from Spergen Hill; figs. 13 and 14, cardinal and lateral views (2x) of original specimens from Bloomington, Ind.

CONOCARDIUM CATASTOMUM.

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Figs. 15-17. Figs. 15 and 17, lateral views of specimens from Spergen Hill (4 and 3x); fig. 16, basal view of the specimen fig. 15.

CONOCARDIUM CARINATUM.

Page 345.

Figs. 18-19. Posterior and lateral views (2x) of an imperfect specimen. Spergen Hill.

CONOCARDIUM PRATTENANUM.

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Fig. 20. Enlarged lateral view (4x) of the only example of the species obtained. Alton, Ill.

CONOCARDIUM MEEKANUM.

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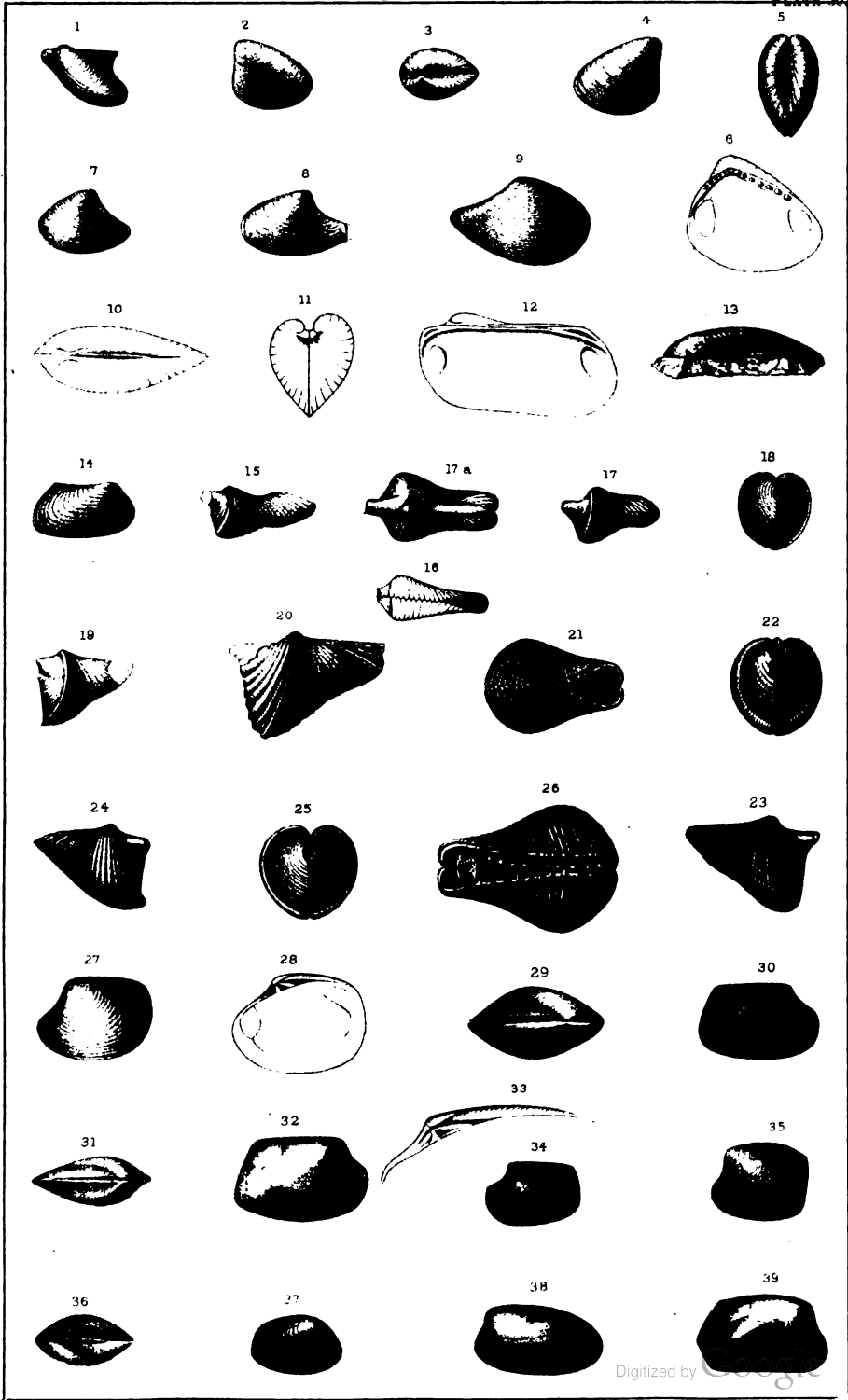
Figs. 21-23. Three views (3x) of a specimen from Alton, Ill.

SPERGEN HILL FOSSILS.

(Lamellibranchiata.)  
ST LOUIS GROUP.

Indiana Geol. Survey.

PLATE 30.





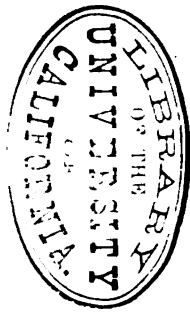


PLATE 30—Continued.

CONOCARDIUM CUNEATUM.

Page 345.

- Figs. 24-26. Figs. 24 and 25, lateral and posterior views (2x) of a specimen from Bloomington; fig. 26, basal view (2x) of one from Spergen Hill, Ind.

CYPRICARDELLA SUBELLIPTICA.

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- Figs. 27-29. Figs. 27 and 29, lateral and cardinal views (3x) of a specimen from Spergen Hill; fig. 28, view (3x) of another specimen, showing hinge.

CYPRICARDELLA OBLONGA.

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- Figs. 30-34. Figs. 30 and 31, lateral and cardinal views (2x) of the principal type specimen. This specimen was given in the Iowa Geol. Rept. as *C. nucleata*; fig. 32, view (2x) of a cast showing muscular imprints; fig. 33, enlargement of the hinge from a separated valve, subsequently collected; fig. 34, view of a very large valve (natural size), subsequently collected. Spergen Hill, Ind.

CYPRICARDELLA NUCLEATA.

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- Figs. 35-36. Lateral and cardinal views of a specimen (4x) from Spergen Hill.

MICRODON ELLIPTICUS, *Whitfield*.

- Fig. 37. Lateral view of the specimen (2x). Spergen Hill, Ind.—*Microdon (Cypricardella)* sp.?

EDMONDIA (?) SUBPLANA.

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- Fig. 38. Lateral view of the type specimen, natural size.

SANGUINOLITES (GONIOPHORA) (??) PPLICATA.

Page 341.

- Fig. 39. Lateral view (3x) of one of the original specimens.

PLATE 31.

NAUTILUS CLARKANUS.

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Fig. 1. Lateral view of the specimen described.

ORTHO CERAS EPIGRUS.

Page 373.

Fig. 2. View of the type specimen, twice enlarged.

CONULARIA SUBULATA.

Page 372.

Fig. 3. Lateral view, twice enlarged, of the most perfect individual.

BELLEROPHON TEXTILIS.

Page 371.

Fig. 4-5. Dorsal and lateral views, twice enlarged, Bloomington, Ind.

BELLEROPHON SUBLEVIS.

Page 371.

Figs. 6-7. View of the aperture of a more recently acquired specimen, and lateral view of one of the originals.

LEPETOPSIS LEVETTEI, *White*.

Figs. 8-12. Fig 8, lateral view of a young specimen, doubtfully of this species, four diam.; fig. 9, vertical view of a large individual, and fig. 10, the same with the shell removed to show the muscular scar; fig. 11, view of a second individual; fig. 12, profiles of figs. 10 and 11.

PLATYCERAS ACUTIROSTRIS.

Page 370.

Figs. 13-15. Figs. 13 and 14, lateral and dorsal views of the same specimen; 15, lateral view of a second specimen, both from Bloomington, Ind.

EUOMPHALUS SPERGENENSIS.

Page 350.

Figs. 16-19. Figs. 16-18, views of a large specimen from later collections, and 19, a view of one of the types, all from Spergen Hill.

EUOMPHALUS SPERGENENSIS, var. PLANORBIFORMIS.

Page 351.

Figs. 20-21. From Bloomington, Ind.

EUOMPHALUS PLANISPIRA.

Page 351.

Figs. 22-23. Upper and lower views of two specimens from Bloomington, Ind.

SPERGEN HILL FOSSILS.

(Univalves.)

ST. LOUIS GROUP.

PLATE 31.

Indiana Geol. Survey.

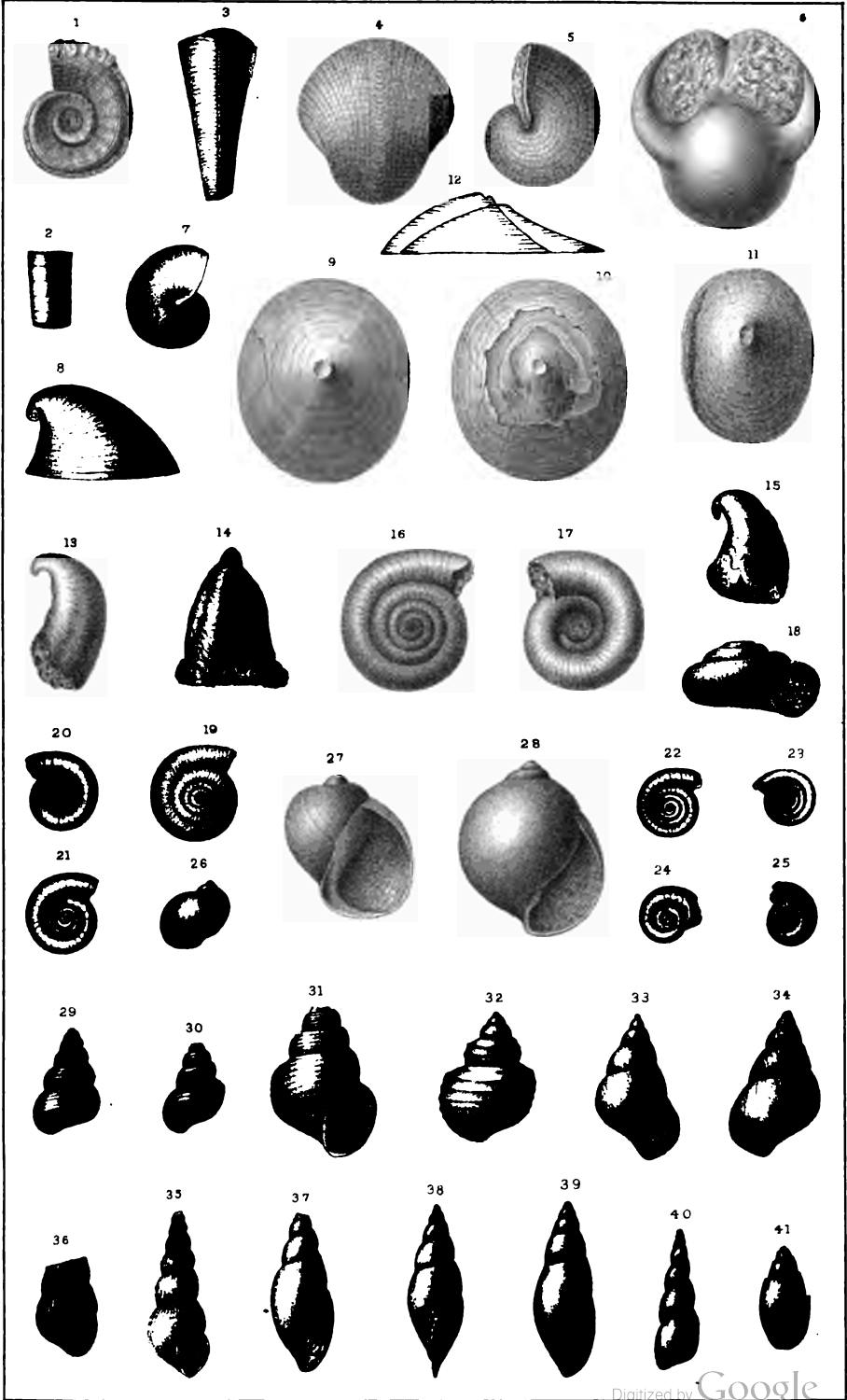




PLATE 31—Continued.

EUOMPHALUS QUADRIVOLVIS.

Page 349.

Figs. 24-25. Upper and lower sides of two specimens from Bloomington, Ind.

NATICOPSIS CARLEYANA.

Page 369.

Figs. 26-27. Back view, natural size, and view of the aperture (2x), Bloomington, Ind.

MACROCHEILUS LITTONANUS.

Page 369.

Fig. 28. Front view of the specimen enlarged four diameters.

CYCLONEMA LEAVENWORTHANA.

Page 363.

Figs. 29-31. Fig. 29, view of a specimen from Spergen Hill, (2 diam.); fig. 30, view of one from Bloomington, Ind., natural size, and fig. 31, view of the aperture of one from Spergen Hill, (2 diam.)

CYCLONEMA SUBANGULATUM.

Page 364.

Fig. 32. Back view of the type specimens, (2 diam.)

HOLQPEA PROUTANA.

Page 368.

Figs. 33-34. Front and back views (2 diam.) of a specimen from Spergen Hill, Ind.

LOXONEMA YANDELLANA.

Page 365.

Figs. 35-36. Fig. 36, enlargement (3 diam.) of a fragment showing the stria; fig. 35, view of a second specimen (3 diam.)

BULIMORPHA BULIFORMIS.

Page 366.

Figs. 37-39. Fig. 37, view of a specimen from Bloomington, Ind. (3 diam.), showing the columella; fig. 38, side view of a smaller shell (3 diam.) from Spergen Hill, showing striae in upper part of lip; fig. 39, front view (3 diam.) of another Spergen Hill specimen.

BULIMORPHA ELONGATA.

Page 368.

Fig. 40. View of the type specimen twice enlarged.

BULIMORPHA CANALICULATA.

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Fig. 41. View of the type specimen enlarged to three diameters, showing the channeled sutures.

PLATE 32.

PLEUROTOMARIA SWALLOWANA.

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Figs. 1-2. Vertical and lateral views (4 diam.) of a specimen from Spergen Hill, Ind.

PLEUROTOMARIA HUMILIS.

Page 353.

Fig. 3. Vertical view (4 diam.) of a specimen showing surface features.

PLEUROTOMARIA WORTHENI.

Page 356.

Fig. 4. Apertural view of the type. (See other figs. Geol. Iowa, 1858.)

PLEUROTOMARIA NODULOSTRIATA.

Page 352.

Fig. 5. Apertural view (4 diam.) of a specimen of medium height.

PLEUROTOMARIA PIASAENSIS.

Page 354.

Figs. 6-7. Lateral and vertical views (3 diam.) of a specimen with sharp periphery.

PLEUROTOMARIA (?) MEEKANA.

Page 353.

Figs. 8-9. Lateral and vertical views of the type specimen (3 diam.) slightly restored.

PLEUROTOMARIA SUBGLOBOSA.

Page 355.

Fig. 10. Lateral view (2 diam.) showing aperture; Spergen Hill, Ind.

MURCHISONIA VERMICULA.

Page 361.

Fig. 11. View of a specimen, five diameters, Spergen Hill, Ind.

MURCHISONIA TURRITELLA.

Page 361.

Fig. 12. View of a specimen twice enlarged, Spergen Hill, Ind.

MURCHISONIA ATTENUATA.

Page 360.

Fig. 13. View of the type, enlarged six times.

MURCHISONIA VINCTA.

Page 363.

Fig. 14. View of the most perfect of the type specimens, (2 diam.)

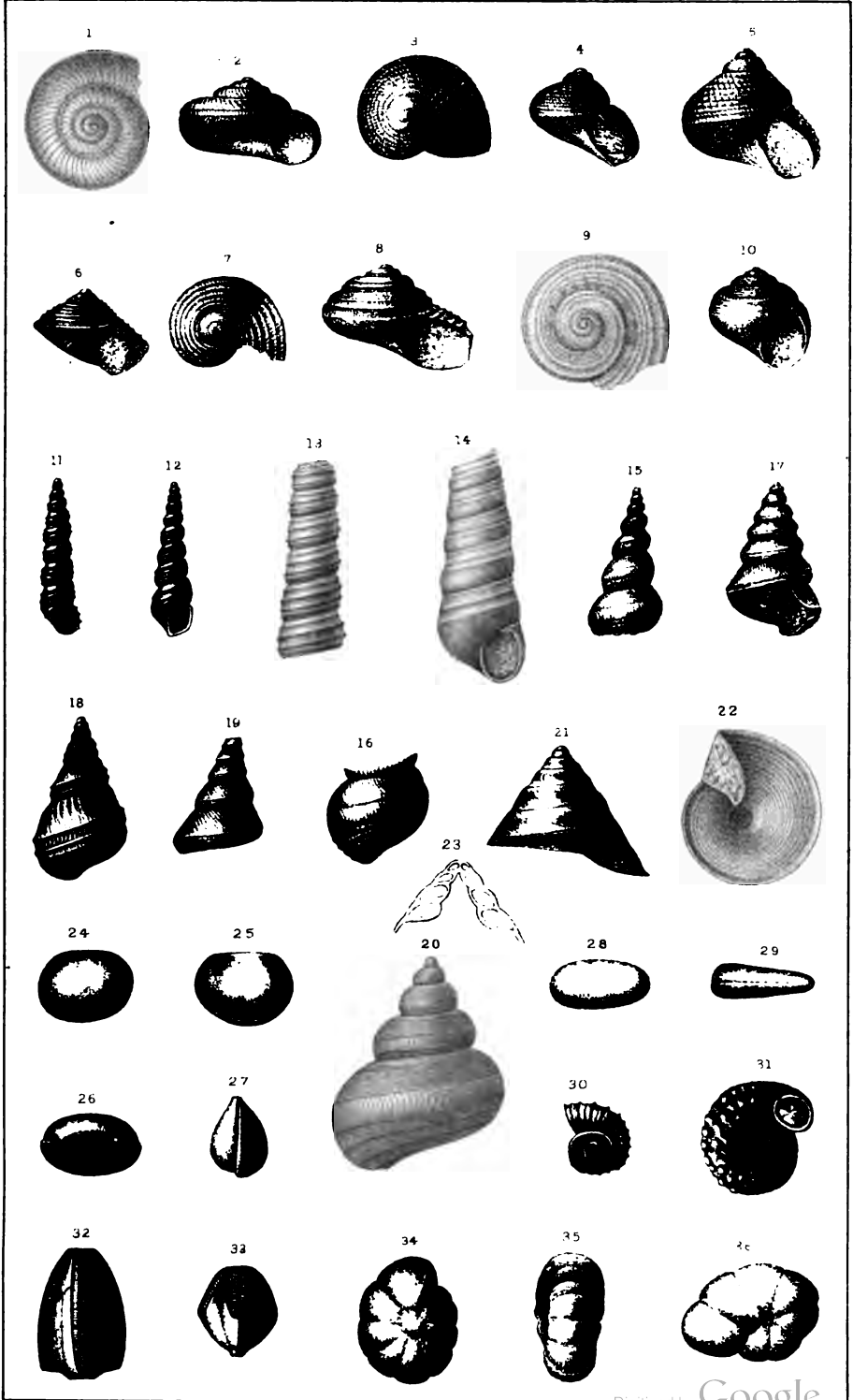
MURCHISONIA TEREBRIFORMIS.

Page 362.

Figs. 15-16. Fig. 15, view of the type (2 diam.); fig. 16, view of the last volution further enlarged and restored in lower part.

SPERGEN HILL FOSSILS.

(Gasteropoda &c.)  
ST. LOUIS GROUP.





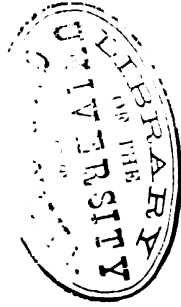


PLATE 32—Continued.

PLEUROTOMARIA CONULA.

Page 358.

Fig. 17. View showing the aperture of the most perfect type specimen (4 diams.), showing slit in the aperture.

MURCHISONIA INSCULPTA.

Page 359.

Fig. 18. View of a specimen from Spergen Hill, enlarged four times.

PLEUROTOMARIA ELEGANTULA.

Page 358.

Fig. 19. View of the type specimen, enlarged twice.

PLEUROTOMARIA TRILINEATA.

Page 357.

Fig. 20. Enlargement to three diameters, of a specimen from Bloomington, showing the features of the species.

EOTROCHUS CONCAVUS.

Page 365.

Figs. 21-23. Figs. 21 and 22, lateral and basal views (2 diams.) of a specimen from Spergen Hill, showing the form and surface features; fig. 23, section of a shell enlarged.

LEPERDITIA CARBONARIA.

Page 375.

Figs. 24-27. Views of a specimen, greatly enlarged, showing the features of the species.

CYTHERELLINA GLANDELLA, *Whitfield*.

Figs. 28-29. Lateral and profile views of a specimen greatly enlarged.

SPIROBIS ANNULATUS.

Page 374.

Fig. 30. View of the lower side of a specimen from Alton, Ill., (2 diams.)

SPIROBIS NODULOSUS.

Page 375.

Fig. 31. Enlarged view of the type specimen (4 diams.)

PENTREMITES CONOIDEUS.

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Fig. 32. Lateral view of a specimen, nat. size, Spergen Hill. For other figures, see Geol. Rept. Iowa, 1858.

PENTREMITES KONINCKANA.

Page 322.

Fig. 33. View of one of the types from Spergen Hill (2 diams.) For other figures, see Geol. Rept. Iowa, 1858.

ENDOTHYRA BALEYI.

Page 321.

Figs. 34-36. Figs. 34 and 35, two views of the same specimen greatly enlarged, showing the prevailing form; fig. 36, view similarly enlarged, of a less symmetrical form.

PLATE 33.

- Fig. 1. *Navicula Placentula* (?)
- Fig. 2. *Navicula* ———? Possibly a *Stauroneis*. (Vorce.)
- Fig. 3. *Navicula* (*Cuspidata*). Variety.
- Fig. 4. *Navicula* ———?
- Fig. 5. *Navicula Major* (Variety) Kg.
- Fig. 6. *Navicula* (*Slesvicensis*) *Dicephala*. Variety.
- Fig. 7. *Navicula* ———?
- Fig. 8. *Navicula Dicephala*. (C. M. Vorce.) *Ambigua*? (Ehr.).
- Fig. 9. *Navicula Roteana*? This form often varies in the spaces of the cross, sometimes being quite small.
- Fig. 10. *Navicula Dicephala*, a variety of No. 8.
- Fig. 11. *Navicula Lanceolata*. (Pritchard.)
- Fig. 12. *Navicula* ———? (With Bands).
- Fig. 13. *Navicula* ———?
- Fig. 14. *Navicula Viridis* (?). Vorce.
- Fig. 15. *Navicula* (possibly a variety of No. 14).
- Fig. 16. *Navicula Lucidula*. (Variety.) Grunow.
- Fig. 17. *Navicula Cryptocephala*.
- Fig. 18. *Navicula* (*Lata*?). Its character is obscure.
- Fig. 19. *Navicula Atoneoides*. (By some called a *Stauroneis*).
- Fig. 20. *Navicula Borealis*. Variety. Ehr. Kg.
- Fig. 21. *Navicula* ———. (Evidently a fragment. It is no uncommon occurrence to find fragments of diatoms which can not be named while in a fragmentary state).
- Fig. 22. *Navicula* (?). There is some doubt as to its class. Vorce prefers to class it among the *Surirella*, and in that case the drawing is of the inside of a compound valve, "showing the inner plate".

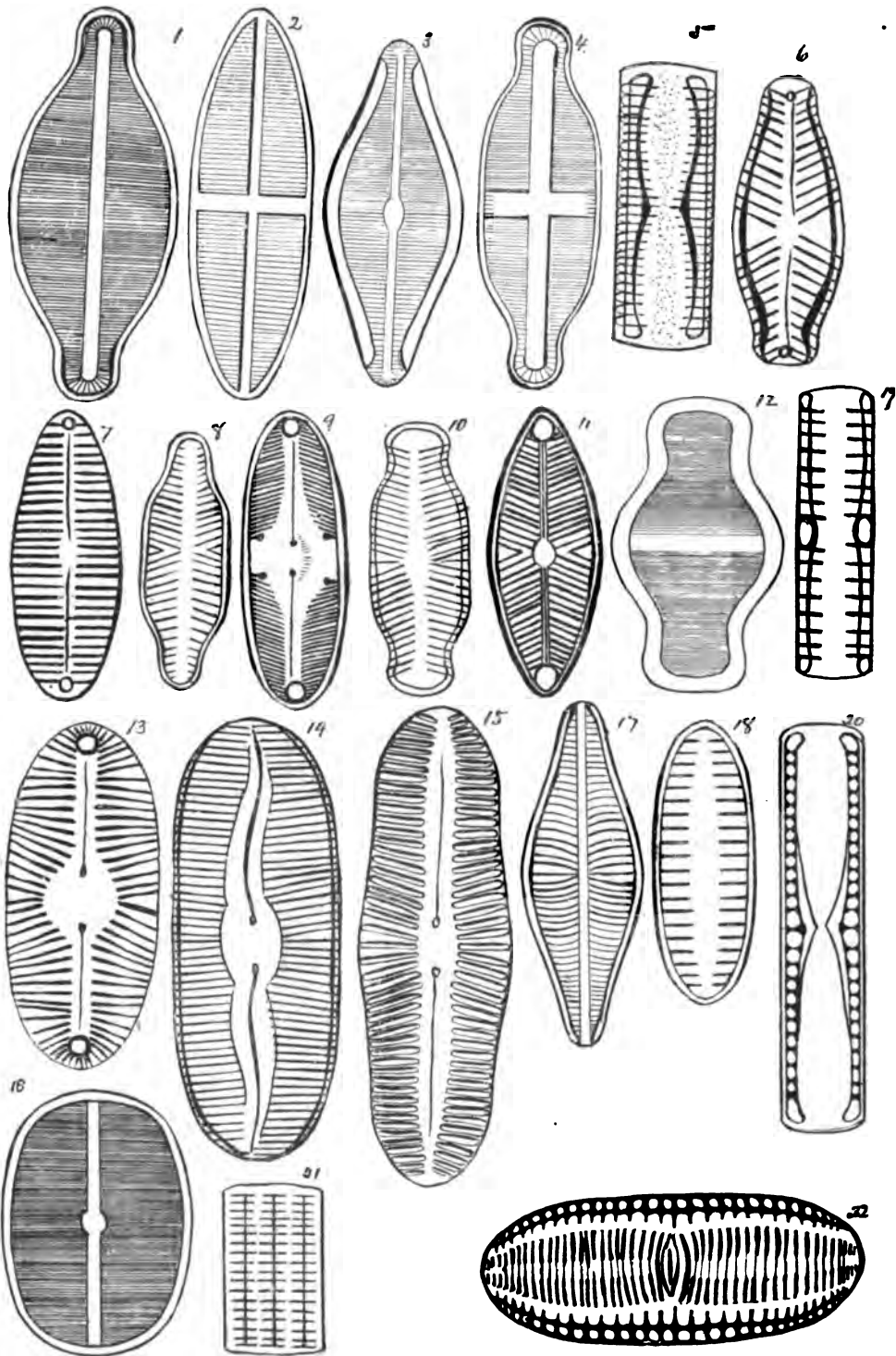






PLATE 34.

- Fig. 1. *Epithemia Gibba* (?) Kutz. This bears a striking resemblance to certain *Navicula*. The difference lies in the center stripe.
- Fig. 2. *Fragilaria Virescus*. (A cluster) 1,000  $\times$ . Found in a pond west of Indianapolis.
- Figs. 3, 4. *Fragilaria (Staurosira) Smithiana*. Grun. Variety. They are difficult to name. No. 3 bears marks of the *Cymatosira Lorenziana*, while No. 4 bears resemblance to *Fragilaria Capensis* of Grun. & Heurck.
- Fig. 5. *Fragilaria Lanceolata* (Northumbrian).
- Fig. 6. *Fragilaria Construens* (var)? Possibly *Tabellaria Flocculosa* var.
- Fig. 7. *Fragilaria Brevastriata*. (Var. Subacute of Grun.)
- Fig. 8. *Fragilaria Ungeriana*. (Grun. Van Heurck.)
- Fig. 9. *Synedra Spathulifaris*. Grun. (Capitata of Ehr.)
- Fig. 10. *Synedra* or *Fragillaria*?
- Fig. 11. *Nitzschia*. A fragment.
- Fig. 12. *Synedra Parallelogram*. (Radiens of Smith.) From the Cold Springs, four miles northwest of Indianapolis.
- Fig. 13. *Synedra Acuti*? It bears some resemblance to the *Oxyrhyncus* (var.) which is described by Kutzing, and is reported as found in Germany only, while the *Acuti* is widely diffused, being found in Asia, Africa and America.
- Fig. 14. *Synedra Lanceolata*.
- Fig. 15. *Synedra Obtusa*. Van Heurck.
- Fig. 16. *Synedra Dicephala*.
- Fig. 17. *Synedra Amphicephala*? (Var. of 16.) Ktz. It bears a resemblance to *Synedra Fulgens*. Var. (Dalmatica. Grun.)
- Fig. 18. *Cymbella Gastroides*. (Kamtschatica? Van Heurck).
- Fig. 19. Possibly same as No. 18, in different view.
- Figs. 20, 21. *Cymbella (Cocconema?) Helvetica*. Var. Van Heurck.
- Fig. 22. *Cymbella (Cocconema) Lanceolata*. Ehr.
- Fig. 23. *Amphora Ovalis*. Van Heurck and Kutzing.

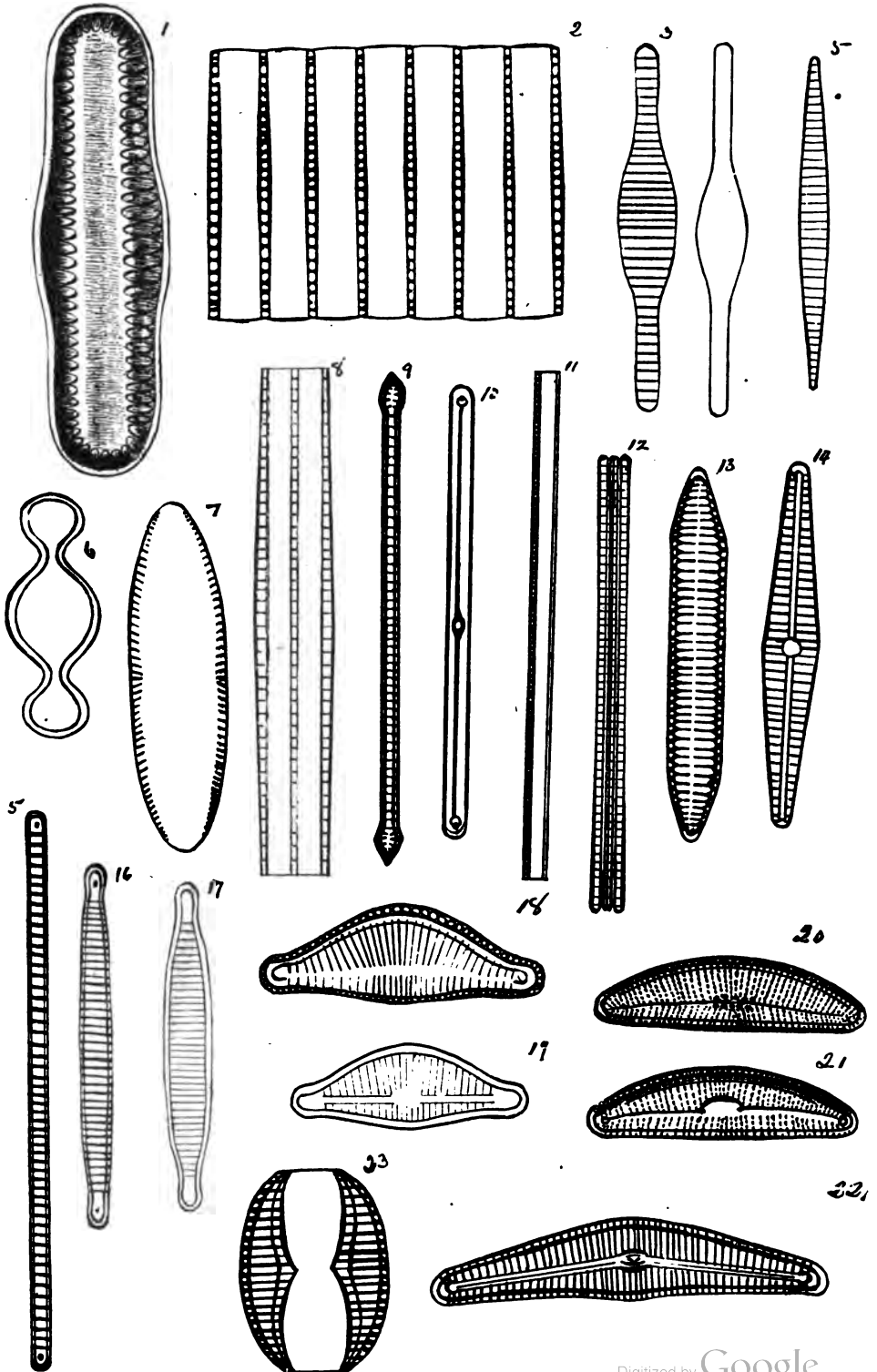








PLATE 35.

- Fig. 1. *Diatoma Constrictum Longatum*. High powers resolve markings on blank spaces between bars.
- Fig. 2. *Diatoma Constrictum*. (Ralfs.)
- Fig. 3. *Diatoma Meridian Circulare* (?) Minor.
- Fig. 4. *Diatoma Meridian Circulare* (?) Variety.
- Fig. 5. *Diatoma (Odontidium?) hiemal*. Van Heurck. This diatom is from pond near Haughsville. It is not abundant, but in the Cold Spring water at times is abundant.
- Fig. 6. *Diatoma Vulgara*.
- Fig. 7. *Achuanthidium Flexillum*. (C. M. Vorce.) 800  $\times$ . Cold Spring.
- Fig. 8. *Cocconeis Pediculus*. Abundant.
- Fig. 9. *Cocconeis Amygdalma*. (Forma Major?) Bands very fine. Somewhat rare. May be a good objective test.
- Fig. 10. *Eunotia Parallela*. Variety. Marked with bars under high powers.
- Fig. 11. *Gomphonema Acuminatum*. Ehr. Van Heurck.
- Fig. 12. *Gomphonema Acuminatum*. Variety. Ehr.
- Fig. 13. *Gomphonema Constrictum*. Ehr.
- Fig. 14. *Gomphonema Acuminatum*. Short, abrupt bars.
- Fig. 15. *Gomphonema Symmetrica*. (Subramosum?) Variety. Kutz.
- Fig. 16. *Hantzschia Amphioxys*. Variety.
- Fig. 17. *Hantzschia Amphioxys* Minor.
- Fig. 18. *Navicula Timodis* (or *Simosa*?) It bears resemblance to *Stauroneis Legumen*, for which it may be mistaken.
- Fig. 19. *Stauroneis* (?)
- Fig. 20. *Pleurosigma Spenceri*. (Acuminatum. Kut.) Under high powers there are seen lines parallel to the border.
- Fig. 21. *Pleurosigma* ————. Found in a pond near Greenwood, Ind.
- Fig. 22. *Nitzschia*. The species not distinguishable.

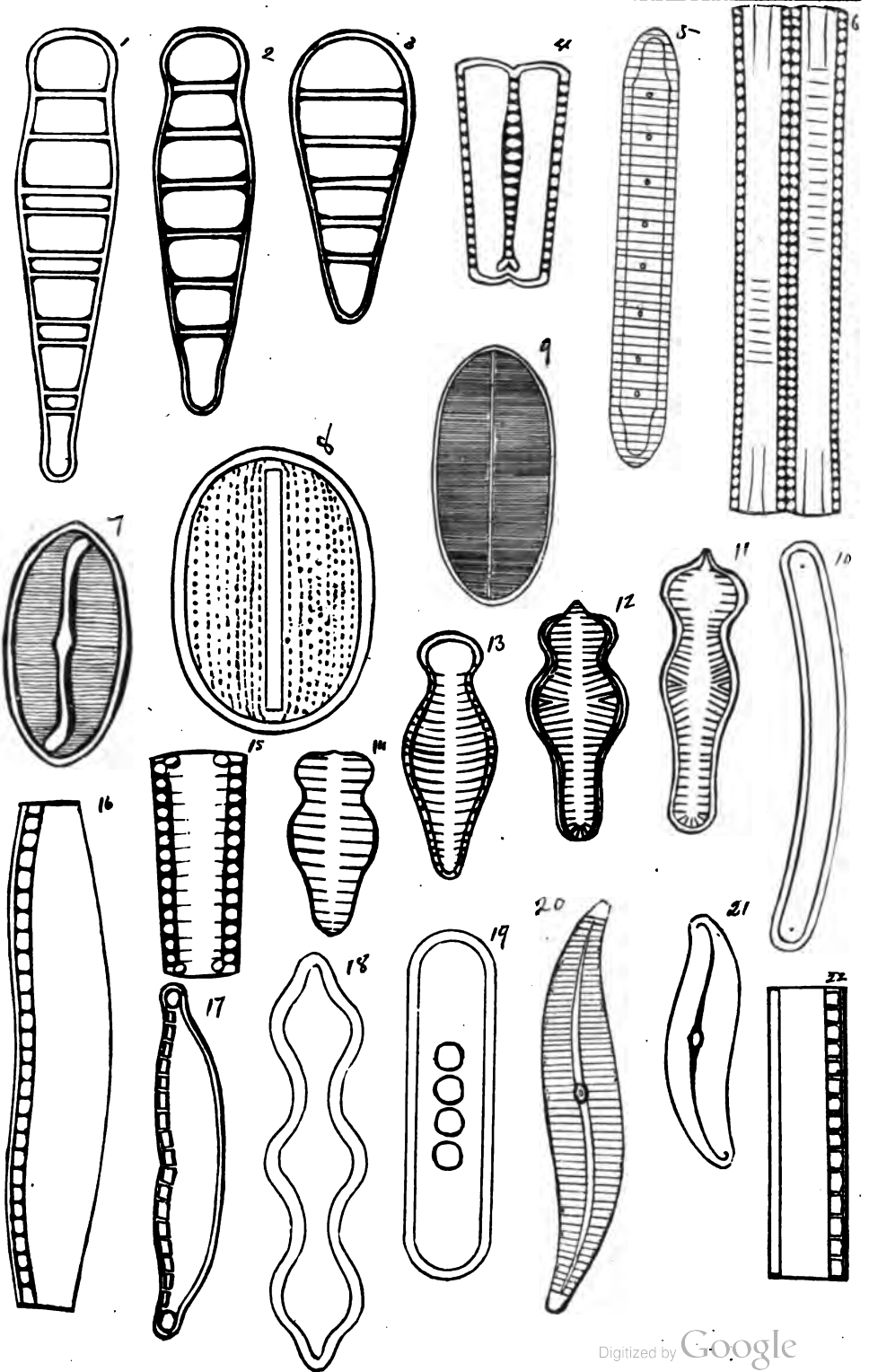






PLATE 36.

- Fig. 1. *Surirella Elegans*. Variety. Ehr. Van Heurck.
- Fig. 2. *Cymatopleura Elliptica*. (Moller Typen Platte.) From Cold Spring, the scene of the Young tragedy. This diatom is very beautiful under the glass, and when once observed will be remembered.
- Fig. 3. *Surirella Ovata Radiata*. With bars. From Cold Spring.
- Fig. 4. *Surirella Ovata Radiata*. With dots.
- Fig. 6. *Surirella Ovata*. Variety.
- Fig. 7. *Meridion Constrictum*. From a pond south of Indianapolis. This will break up into single valves.
- Fig. 8. Is a single frustule of No. 7, but chances to be of a shorter variety.
- Fig. 9. *Surirella Biseriata*. (C. M. Vorce.)
- Fig. 11. *Achuentidium Flexellum*. Smith.
- Fig. 12. *Surirella* ————. From a pond at Shelbyville, Ind.

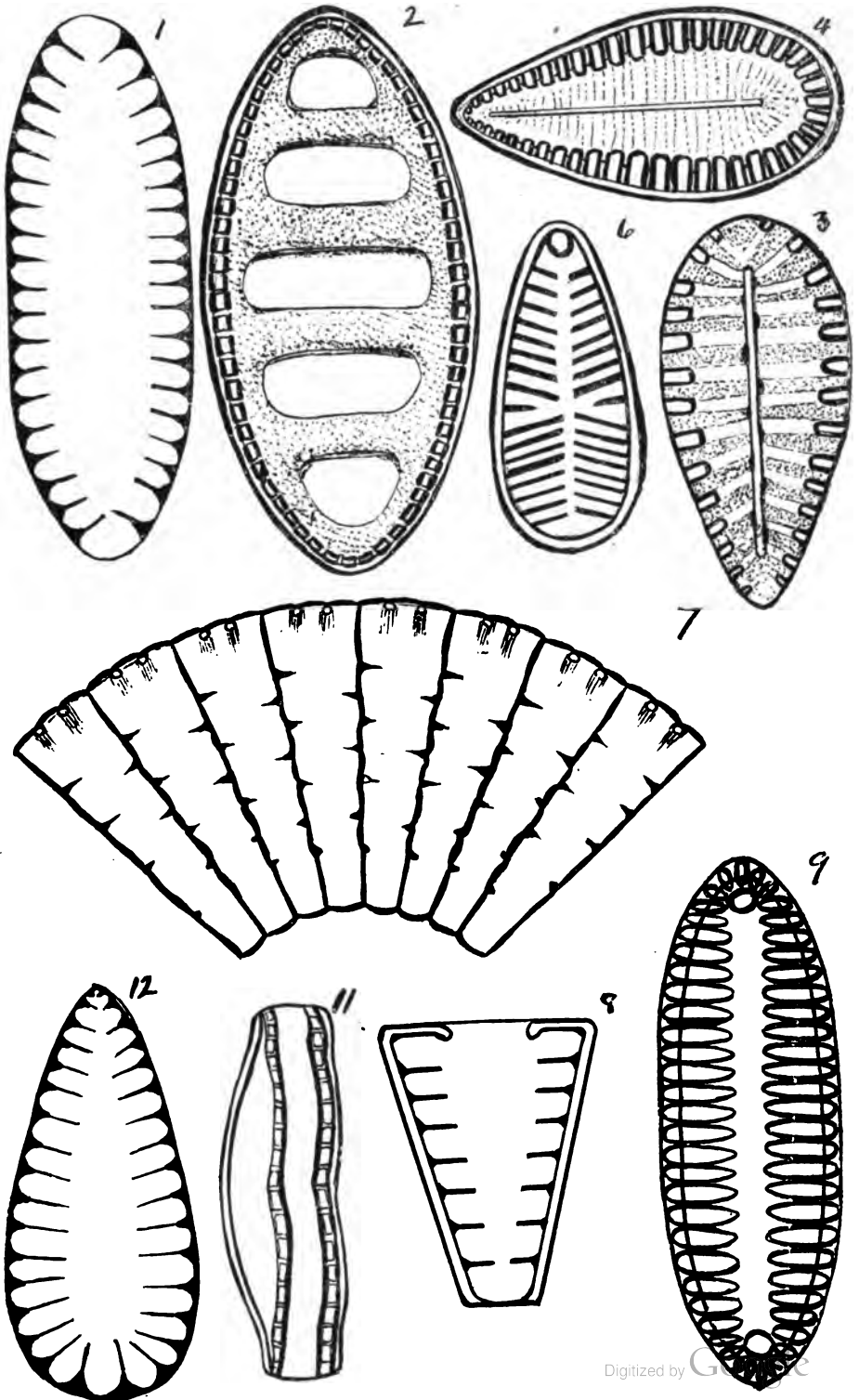








PLATE 37.

- Fig. 1. *Melosira* ———. (Mary?) (Possibly a *Cyclotella* of Van Heurck.)  
Found in a pond between Indianapolis and Haughsville.
- Fig. 2. *Melosira* (Varians?) 1,000  $\times$ . (Center marked with dots.)
- Fig. 3. *Melosira* (Gaillonella?) Hyporborea. Grun. 1,000  $\times$ . Found in abundance in ponds around Indianapolis. It will often be overlooked as a grain of sand.
- Fig. 4. *Melosira* (Marion?) 1,000  $\times$ . Smith and Van Heurck have nothing corresponding with this.
- Fig. 5. *Cyclotella* Meneghiniana. (Vorce.) It resembles the *Melosira* *Spiralis* of Ehr.
- Fig. 6. *Cyclotella* Kutziana. (Resembles *Melosira* Sol, a variety of the *Gaillonella* Sol of Ehr. Brightwell calls it the *Cyclotella* *Radiata*.)
- Fig. 7. *Cymatopleura* Solea. Cold Spring.
- Fig. 8. *Synedra* Diacephala. Bears resemblance to a *Schizonema*.
- Fig. 9. *Suirella* Ovata Minor.

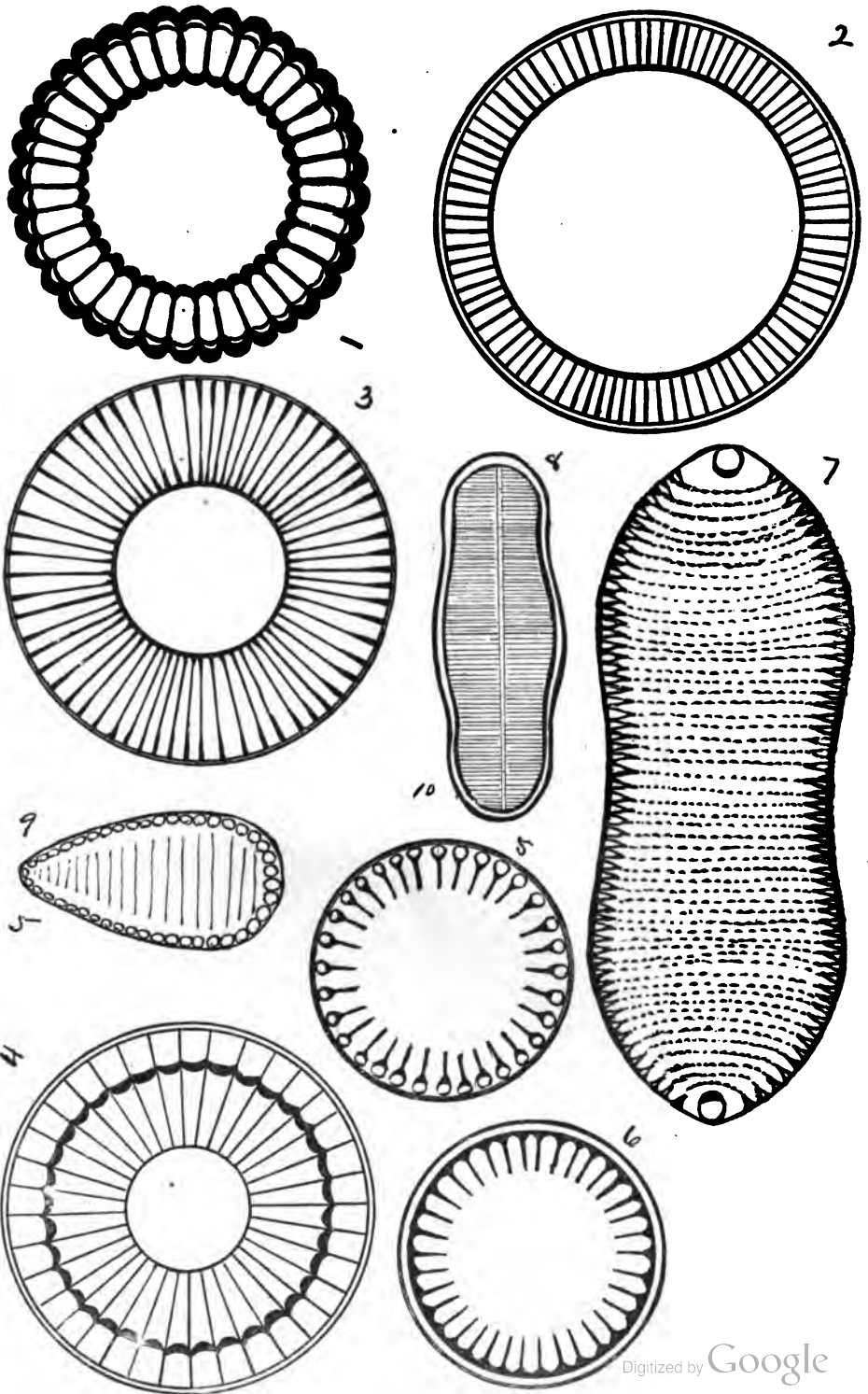
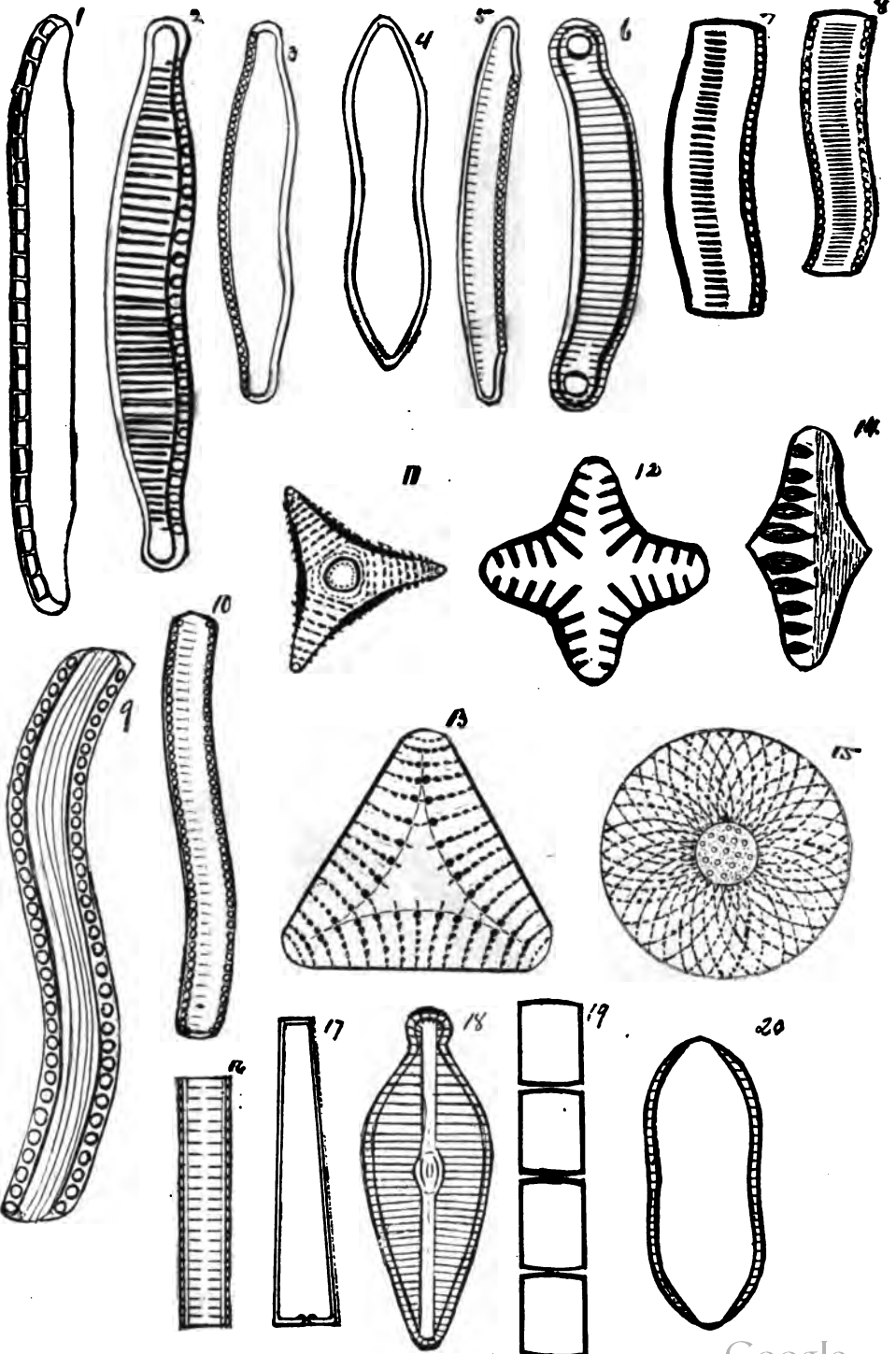




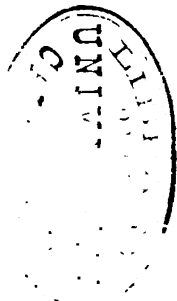


PLATE 38.

- Fig. 1. *Nitzschia Bicephala*. Large. It seems to be the *N. Debiles* of Van Heurck.
- Fig. 2. *Nitzschia Amphioxys*. Long.
- Fig. 3. *Nitzschia Amphioxys*. Short. Variety.
- Fig. 4. *Nitzschia Coarctata*. Groupe Tryblionella. Van Heurck.
- Fig. 5. *Nitzschia* ———? Curved. From pond west of White river, at Indianapolis. Since have found the same in water from Cold Spring.
- Fig. 6. *Eunotia* (?). Possibly *Himantidium*. Sometimes in pond near Cold Spring. 1,000 ×.
- Fig. 7. *Nitzschia Sigmoida*. Obtusa. With bars and dots.
- Fig. 8. *Nitzschia* ———?
- Fig. 9. *Nitzschia Longa* (?). East of Indianapolis, near Michigan road.
- Fig. 10. *Nitzschia* (*Vermicularis*?).
- Fig. 11. *Triceratium* (*Actinoptychus*?). Vorce calls it *Staurastrum Alternans*, after Ralfs. It generally occurs double.
- Fig. 12. *Bidulphia Decipiens*. Variety. Van Heurck. 1,000 ×. Found at Cold Spring. Rare. (*Fragillaria Construens* (*Odontidium*.) (Vorce).
- Fig. 13. *Staurastrum Asperum* (Ralfs). 1,000 ×. This bears a striking resemblance to the *Triceratium*.
- Fig. 14. *Nitzschia* (*Sinnata* variety). Vorce calls it *Odontidium*.
- Fig. 15. *Hyalodiscus Collettensis*. A few of these are found in the pond on north side of the road leading from Indianapolis to Haughsville, on east side of White river. It is difficult to account for its occurrence here.
- Fig. 16. Is a fragment.
- Fig. 17. *Gomphonema* ———?
- Fig. 18. *Gomphonema Sphaerophorum*, *turgidum*. Ehr. From a brook near Zionsville, Ind.
- Fig. 19. *Melosira Varians* (?).
- Fig. 20. *Trybleonella* ——— (?).













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