ORGANIZATION AND WORK.

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 palmiest 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 reconnoisances 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.

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—Carlon & 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	
			$265 75
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	
			250 00
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	
			269 65
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	
			552 92
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	
			241 25
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. R. 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	
			218 38

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	
	Total		8,486 85
	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
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 indispensible 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.

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 extremeties 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:

	Pittsburgh.	*Indiana.*
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 necessaries 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 chalks 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.

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 primeval" 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° 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 frem 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 Sourthern 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.

*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 put no numbers; they are to be distinguised by this mark: "¼ S."

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

R. 9 E. T. 5 N. 26	R. 9 E. T. 5 N. 25
R. 9 E. T. 5 N. 35	R. 9 E. T. 5 N. 36

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 grond 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.
Chs.	*Lks.*	
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.
Chs.	*Lks.*	
12	59	A stream, 25 links wide, course S.
19	50	Enter prairie.
40	00	Set temporary ¼ 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.

WEST.		Corrected West, between Sections 25 and 36.
Chs.	*Lks.*	
39	93	Set post at average distance on true line for ¼ Sec. corner in prairie, where raised a mound.
79	86	Section corner.
NORTH.		Between Sections 25 and 26, T. 4 N., R. 9 E., first Meridian.
Chs.	*Lks.*	
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.....

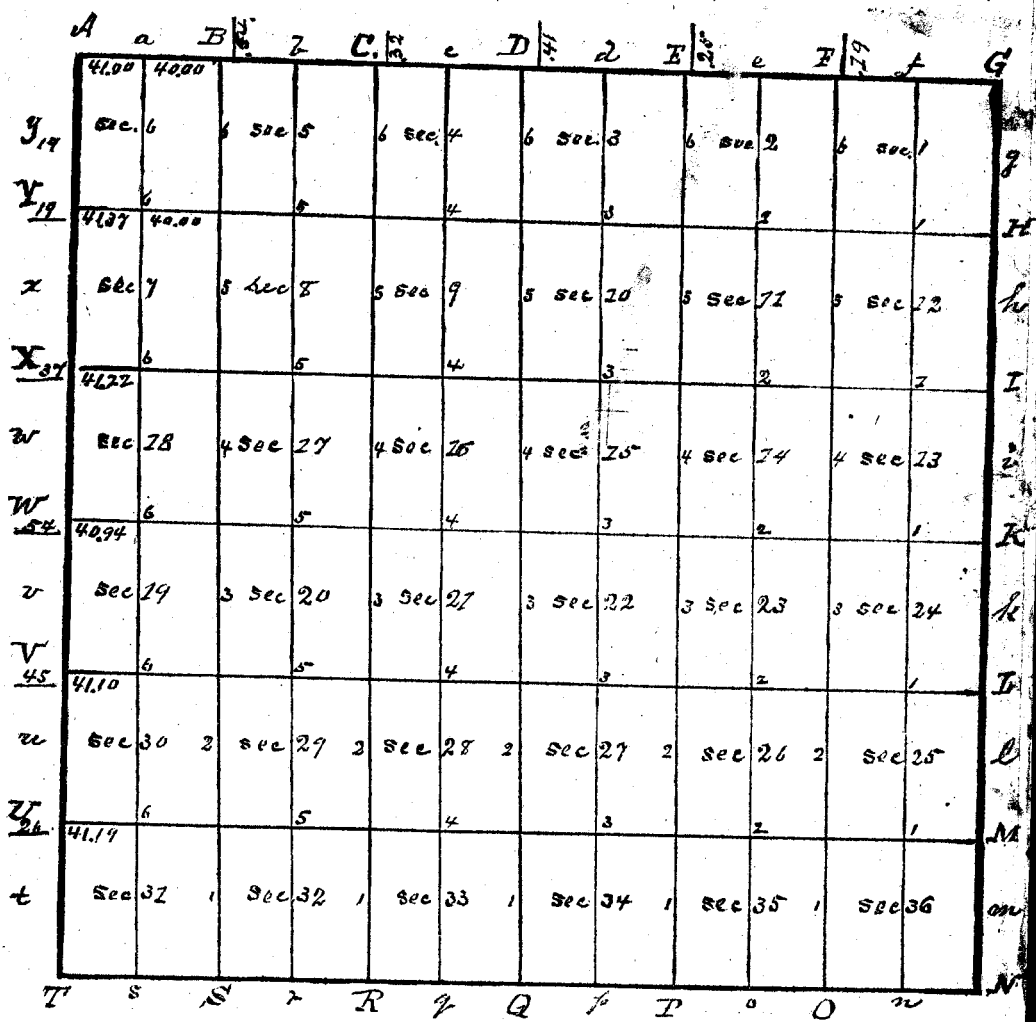
INSTRUCTIONS FOR SUBDIVIDING TOWNSHIPS.

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 rectilineal 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.



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

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.

ARCHÆOLOGY.

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-poie,*" 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-poie,*" 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 though 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-gwun-nash-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, Godfroy 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-auk-e-shaw.*" The word "*Pi-auk-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-

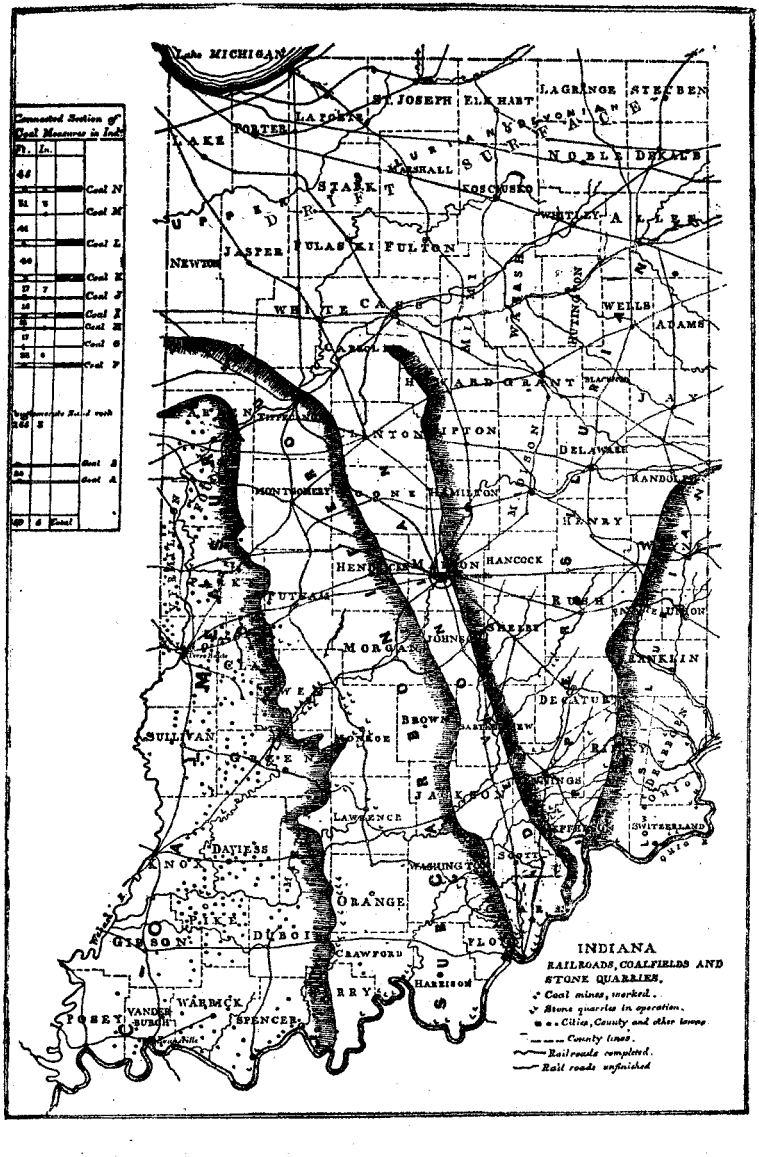
niting from the autumnal fires. This chalk, or calcined shale, is found in great abundance along the streams, and the Indians used it as paint. The signification is preserved in the French word, Vermillion, synonymous with the English word, Vermillion. The name "*Pi-auk-e-shaw*" is recorded in documents 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-auk-e-shaws*" for *that* reason. In time they were called the upper "*Pi-auk-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-auk-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-gwinn-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.


Lake MICHIGAN
LAGRANGE
STEUBEN
ST. JOSEPH
ELKHART
LAPORTE
PORTER
LAKE
NOBLE
DEKALB
MARSHALL
STARKE
KOSCIUSKO
WHITLEY
ALLEN
JASPER
PULASKI
FULTON
NEWTON
WHITE
CASS
WELLS
ADAMS
HOWARD
GRANT
JAY
DELAWARE
RANDOLPH
MONTGOMERY
HENRY
HANCOCK
MORGAN
JOHNSON
DECATUR
FRANKLIN
SULLIVAN
GREENE
BROWN
JACKSON
LAWRENCE
SCOTT
JEFFERSON
SWITZERLAND
DAVIESS
KNOX
ORANGE
WASHINGTON
CLARK
FLOYD
GIBSON
DUBOIS
CRAWFORD
HARRISON
PERRY
POSEY
VANDERBURGH
WARRICK
SPENCER
Connected Section of Coal Measures in Indiana
Coal N
Coal M
Coal L
Coal K
Coal J
Coal I
Coal H
Coal G
Coal F
Coal B
Coal A
Coal
INDIANA
RAILROADS, COALFIELDS AND STONE QUARRIES.
Coal mines, marked.
Stone quarries in operation.
Cities, County and other towns
County lines.
Railroads completed.
Rail roads unfinished

OUTLINE GEOLOGY OF INDIANA.

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 bowlder 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	"
Total	4,605	"