

**INDIANA. DEPARTMENT OF GEOLOGY
AND NATURAL HISTORY. FOURTEENTH
ANNUAL REPORT. PART
FIRST, GEOLOGY OF NATURAL HISTORY;
PART SECOND, POST-PLIOCENE
VERTEBRATES OF INDIANA. 1884**

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E. D. COPE & JAS. WORTMAN

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2577

INDIANA.

DEPARTMENT

or

Geology and Natural History

(FOURTEENTH ANNUAL REPORT.)

Part First, Geology and Natural History.

Part Second, Post-Pliocene Vertebrates of Indiana.

(By Prof. E. D. Cope and Jas. Wortman.)

JOHN COLLETT,
STATE GEOLOGIST.

1884.

TO THE GOVERNOR.

INDIANAPOLIS:

WM. B. BURFORD, STATIONER, PRINTER, LITHOGRAPHER AND BINDER.

1884.

STATE OF INDIANA,
OFFICE OF STATE GEOLOGIST,
November 2, 1884. }

HON. ALBERT G. PORTER,

Governor of Indiana:

Herewith I transmit to Your Excellency the Fourteenth Annual Report of the State Geologist, being for the year 1884, embracing the labors of myself and assistants in the field, study and cabinet, with detailed survey of several of the most important counties of the State. To this is added a study of the Post-Pliocene Vertebrates of Indiana, by that distinguished comparative anatomist, Edward D. Cope-

JOHN COLLETT,

State Geologist.

STATE OF INDIANA,
EXECUTIVE DEPARTMENT. }

Received November 8, 1884, examined by the Governor, and transmitted to the Secretary of State, to be filed and published according to law.

FRANK H. BLACKLEDGE,

Private Secretary.

Filed in my office this 11th day of November, A. D. 1884.

W. R. MYERS,

Secretary of State.

DEPARTMENT OF GEOLOGY AND NATURAL HISTORY,
INDIANAPOLIS, IND.

JOHN COLLETT, State Geologist.

PLEASE ACKNOWLEDGE RECEIPT OF THIS VOLUME.

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

State Museum and Office, corner of Market and Tennessee Streets.

ROSTER.

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Chief of Department, and State Geologist.

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PROF. OLIVER P. HAY, Irvington, Ind.

PALEONTOLOGISTS.

PROF. ED. D. COPE, Philadelphia.
PROF. JAS. L. WORTMAN, Philadelphia.

INTRODUCTION.

The rapid growth of Indiana in population, and its widespread and multiplying industries, stimulates research, and renders important every newly discovered feature in the mineral and agricultural resources of the State.

It is the object of the geologist in prosecuting his survey of the State, to make it as searching as possible, and turn to use every object that will serve to cheapen and foster these industries. Things that appear common and worthless in themselves when properly studied and brought into combination with one another in a suitable manner sometimes give rise to products of great utility, and furnish employment in a direction that provides a new field of operation, and draws from those industries where there is a superabundance of laborers seeking to be employed.

Chief among the industries of the State is agriculture, and this art has for its foundation the soil. The soil of Indiana in its virgin condition compares favorably with that of any Western State, and the portions in cultivation yield cereal and grass crops fully up to those of the most favored portions of the Union, but from the very nature of the origin of this soil, we find great irregularity of productiveness in almost every field; in farmers' parlance, the land is spotted. The siliceous and muddy sediments formed by the disintegration and grinding down of the rock-burdened regions that lay to the northward, by glaciation and its distribution by water, separated the material into mud more or less argillaceous, argo-siliceous, sandy and gravelly soils. Where the former character of soil prevails it is stiff, very retentive of water, and in its natural condition, no matter how much pains may be taken in the tillage to make it

produce even a moderate crop of any farm product. This may be taken as the worst form of ordinary dry land that the frugal farmer has to deal with, and we find it grading down through every variety of soil to that which may be termed purely "sandy." In passing over the country one can see in almost every field that has not been drained ashen-colored spots on which there has been a very sparse yield of grain or grass. They are to be seen on the highest as well as the lowest elevations, and when first cleared for farming purposes, in most cases, were the home of the craw-fish, whose chimney-capped holes gave proof of their presence. These crustaceans live in fresh water, and on inspection their holes will be found to lead down to permanent water, and this at no very great depth. No amount of fertilizing will render such land productive, and there is but one effective remedy, underdraining.

Other names given to such lands by farmers are "cold land" and "sour land." Plants can not fully mature when their roots are in a substratum of water. By capillary attraction and the influence of the sun, the water is brought to the surface and there evaporates. This evaporation robs the soil of its heat, which goes off in the vapor, and the name of "cold land" is therefore very properly applied to such soils. Under this process of evaporation at the surface, a circulation is kept up from below upwards, and the roots of the plants are not only chilled but they are deprived of a free circulation of warm air, which is as essential to the welfare of the plant as it is to the lungs of animals. It has been one of the main objects in the prosecution of the Geological Survey to make known the physical defects of the lands, and call attention to the importance of tile underdrains as the only sure means of remedying these serious drawbacks on successful culture, and we now find the people everywhere fully aroused on the subject, and innumerable unproductive fields have been underdrained, and the good effects resulting from it have been so apparent that manufactures of drain tile have been established in almost every county. Abundant clays suitable for making these tile can be had in all parts of the State, and the industry has become one of great magnitude, and gives employment to a large number of men and boys.

The improvement thus wrought to agriculture is not alone productive of large moneyed gains to the farmer, but the

thorough draining of the land has removed the cause of malarial diseases; the "ague belt of the Wabash" has been almost obliterated, and bilious fever, once so common in all parts of the State, is now seldom known within its borders. Indeed, I know of no outlay of money that has brought so beneficial a change in the prosperity and sanitary condition of the State.

COAL LANDS.

The productive coal lands of Indiana embrace about 250,000 acres. Before the inauguration of the Geological Survey this coal scarcely found a market except for smithing purposes. The supply for house purposes was mostly brought from the distant fields of Pennsylvania, where it was supposed, in popular parlance that good coal could alone be found; and the consumption of the latter coal was almost exclusively confined to cities and large towns.

The Geological Reports showed the abundance of coal in the State and its excellent quality. They were read, believed and quoted. In this way the resources of the State were advertised to the world and the attention of capitalists, miners and manufacturers was attracted. Before the Survey, the coal lands of this State were worth from \$2 to \$10 per acre. They now sell readily at from \$50 to \$200 per acre, while Indiana coal is used to a very large extent by railroads and manufacturing establishments, and for household purposes. Not only have its uses extended over our own State, but it finds a profitable market in our neighboring States, and extensive shipments are made as far west as the State of Kansas. The Reports issued showing the good quality of our coal have either suggested or aided the construction of four or five important railroads, and prepared the way for others.

Placing the average extent of counties included in the coal regions at 250,000 acres, the increased value of previously unproductive land would exceed \$30,000,000, and adding the benefits derived from the setting up of forges, furnaces, factories and mills, and the building of railways, it is probably within the mark to state that the aggregate increase in values resulting from the development of the coal fields has reached \$100,000,000. This great benefit to the State has been brought about to a very great extent, if not altogether, by the labors of

the Geological Survey, and it should also be remembered in this connection that the money invested in operating our coal fields is largely foreign capital which has been brought within our reach for the purposes of taxation.

Such results alone represent more than a thousand per cent. profit on the cost of the Survey. But many of the equally suggestive facts remain to be stated. The increased shipments from the town of Brazil, in Clay county, represent annually more money than the entire cost of the Survey. Ten years ago a few carloads per annum constituted the entire export trade; and the same statement holds equally true in regard to the Washington mines, in Daviess county. The annual shipments are now from 250,000 to 300,000 tons, and the proprietors of mines are glad to arm themselves with analyses and letters from the State Geologist showing the purity and excellence of Indiana coal, by means of which they have built up an extensive shipping trade, while the cannel coal of Daviess county, by reason of its superiority as a grate fuel and for its illuminating qualities, now commands a full market in all directions outside of this State. The proprietors of coal mines are very frank to acknowledge the benefits derived from the Geological Survey.

There are 206 mines in nineteen counties of the State, employing 5,403 men, producing 2,500,000 tons of coal, requiring a capital of \$1,600,000 for the present year.

THE BUILDING-STONE QUARRIES.

The Reports also show that Indiana has more than two hundred square miles of the best building stone to be found in any Western State, if not in the world. This stone has been found in great variety of color and grade, and the tests applied have shown it to be of such enduring strength as to create a large demand. In this way another channel has been opened for the investment of large sums of money by Eastern capitalists, and many quarries are now being operated by skilled workmen, with the aid of the most approved machinery and tools. The product of these quarries, which a few years ago did not exceed \$30,000 per annum, will, during the present year, amount to a very large sum. The citizens of Owen, Monroe, Lawrence, Washington, Harrison and other counties, fully appreciate the assistance they have received from the Geological Survey, and