FOSSILS AND THEIR VALUE.

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I.

THE USE OF FOSSILS.

In writing for the understanding of the people generally, it is hard to find terms or phrases suited to convey clearly the nature and the importance of that connection which a knowledge of fossils bears to an intelligent study of even economic geology, Every geologist knows full well that most people verily believe science to be a humbug. There is an abiding popular faith in what is called "practical knowledge," a phrase that covers all manner of blunders, discouragements and disasters. Science is, in fact, the only true practical knowledge, and there is no such thing as permanent success disconnected from business done upon scientific principles. Geology, for instance, is simply a knowledge of the earth's materials. Out of these materials come all the substances which go into the arts, the commerce and the subsistence of mankind. Geology is not, therefore, a mere study of rocks for curiosity's sake. It is the study of the earth for man's sake. To properly study the earth we must first get possession of a key to its secrets, or to a part of its secrets, at least. It has been demonstrated that the fossils found in the rocks furnish this key. Geologists know this so well that they take it too much for granted that the people know it also. It would seem to be the duty of this department to write for the people rather than for the geologists. The people of Indiana pay for the geological work of the State in order that they may be nformed, along with all the rest of the world, upon the matters connected with a proper understanding of Indiana's physical resources. Many persons of considerable intelligence come to the museum of minerals and fossils, and go away scoffing at the possibility of such a collection of objects ever having any bearing whatever on the development of the State. So-called "practical" men are fond of asserting that all geologists are cranks, and all scientific investigators mere theorists. One thing, however, is very notable; there is not a single instance on record

of a man who, after giving geology a fair study, ever denied that its importance is very great. It is those only who are ignorant of the truth who profess a contempt for it.

Coming now to a short study, in the plainest way, of the relations between a practical knowledge of fossils and the proper understanding of the formation of the earth, let us first take the simplest examples at our command. If any particular general deposit of stratified rock be examined we shall find certain fossil forms, either vegetable or animal, or both, peculiar to that rock alone. This being demonstrated, we may be certainly able thereafter to identify the rock by its fossil forms, no matter in what locality found. By long study and careful comparisons, geologists all over the world have been able to describe, figure and classify a vast number of these fossils and assign to each genus and species its locality or horizon in the rocks of the earth. Hence it is that a museum of fossils has a great value, as it holds the specimens from which it is easy to determine the name and locality, as well as the peculiar formation holding it, of any fossil in question. For simple instance, a citizen of Indiana living in Carroll County came to the State Geologist and claimed that he had found coal while boring a well in that county. The Geologist immediately told him that he was mistaken, that it was quite impossible for coal deposits to exist in the region indicated. How did the Geologist know this? He knew it because he had fossils from the topmost fossil-bearing surface rocks in that county, which showed those rocks to be of the Devonian age—rocks deposited long prior to the rocks of the carboniferous or coal-bearing age. This was a test which could not fail. The apparently useless fossils of the cabinet, and the apparently dry and useless reports of the State Geologist, here showed their value to the citizen, who, but for their information, would have been tempted to expend large sums of money in trying to demonstrate that Devonian black shale is coal. Another case in point was that of a gentleman who, in boring a well for gas, struck a very hard stone which he reported to be gray granite. The State Geologist asked for a piece of the stone, and a fragment was brought to him, which contained a fossil of the Niagara limestone, and which readily dissolved under the action of acid. Here was perfect proof that the rock reached was not granite, but was limestone and of the Niagara formation, a formation which lies far above the granite when in place. It is true that limestone is easily distinguished from granite by the naked eye, but the testimony of the fossils goes to the age of the rock and its proper place in the crust of the earth. It is testimony which always amounts to conclusive evidence. No man who knows whereof he speaks will ever contradict it, nor is there any better source of evidence likely to be discovered touching the remote history of the processes of nature.

So it will appear plain to even the most unscientific mind that fossils really have a use, and may serve civilization a valuable turn; for the moment that a cabinet of specimens ceases to be a mere collection of curiosities, it begins to take on a practical and precious significance to the student and to the broad-minded business man as well.

It is not, however, the greatest value of geology that it has a strong bearing upon the physical development of the countries in which its results are applied. There is a higher function of the science, which is to broaden the intelligence of the world, and thus to aid in impelling civilization along the best lines of progress.

What are fossils? In a general way, a fossil is any object, organic or inorganic, which has been preserved in the rocks of the earth, and which testifies of a past period of terrestrial life. Even the implements made by prehistoric men are, if found imbedded in the earth, strictly fossils. This admitted, the view widens at once, and we see that the study of these unearthed remains may tell a story even more reliable and indisputable in many particulars than the written histories left us by men.

That fossils are of great use, then, can not be questioned. They are the alphabet of that language in which the records of nature are written on the rock tablets of our earth. This alphabet must be learned before those records can be read and understood; and, after all, the lesson is not so difficult as it might at first appear to be. Much depends upon the spirit in which the task is undertaken.

II.

THE NATURE AND DISTRIBUTION OF FOSSILS.

Organic fossils are of two kinds, *animal* and *vegetable*, and they represent a great variety of genera and species, most of them quite extinct at present.

Inorganic fossils, as we shall consider them, are confined chiefly to objects manufactured by prehistoric men.

Animal remains, found in a fossil state, are distribnted throughout the sedimentary rocks of the earth from the lowest limestones of the lower Silurian formation up to the most recent deposits on the surface of our alluvial areas. It is scarcely necessary to consider here the shadowy and doubtful remains claimed to have been found in certain of the older rocks. We may safely begin with the lower Silurian limestones as the lowest legible register of the fossil history of animal life. These fossils appear to have been almost wholly deep sea animals of simple structure comparatively and of a low order of life. A great number of them can be compared in general structure with the simpler shell-fish of the present time, and, so perfectly have their forms been preserved, we can figure, describe and classify them with almost as much accuracy as can be applied to living organisms. Moreover, the science of comparative anat-

omy has been so perfected that we can certainly assign to every part of any fossil form its function in life, and thus demonstrate the habits and mode of existence, and finally the habitat of the animal while living. Indeed it is perfectly possible for the expert comparative anatomist to reconstruct the form of an extinct species by the clue furnished through the study of a single and even minor part of the animal.

It has been shown by a comprehensive survey of all the best defined facts resulting from paleontological study that organic life has probably developed gradually from a lower to a higher state, and from general to special forms through all the past ages. The nature and the distribution of fossils settle this theory pretty clearly, and the facts of the post-fossil period do not conflict with it.

From the Lower Silurian to the Upper Silurian, thence to the Devonian and on up through the Carboniferous to the Drift deposits, the rocks of Indiana are marked by characteristic fossils by which each stratum may be distinguished from all the others. The same may be as well said of the stratified rocks in every country on the globe.

Vertebrate animals have left their remains in these rocks, so as to be certainly identified as far back as the Devonian age, early in which fishes must have swarmed in the waters. In the Devonian strata of Indiana, however, few perfect impressions of these fishes have been found, though teeth, scales and fragments of other parts have been gathered in great abundance, mostly in a rather imperfect state, owing to the conditions under which they were deposited.

The Carboniferous Age is represented by rocks bearing a wonderful amount and variety of plant fossils, the vast deposits of coals themselves being the result of vegetable accumulations. Besides the plants, these interesting rocks contain a great number of curious and characteristic sea animals, among which the crinoids have, perhaps, attracted most attention, though the *pentramites*, the *archimedes* and the *star fishes* have claimed a great deal of discussion.

The fossils of the Drift proper are water-worn and ice-worn pebbles and bowlders (these may properly be termed fossils in this connection) and worn fragments of coal, iron ore, granite and greenstone set in a body of peculiar blue clay. These inorganic fossils antedate and underlie the superficial formations in which are found the remains of the mound-builders, the flint, copper and pottery implements of various Indian tribes, and the skeletons and fragmentary remains of various huge extinct animal species like the mastodon and mammoth.

A large number of so-called sub-fossil remains have been unearthed from the alluvial deposits of Indiana, but these have no important bearing upon the geology of the State, the species being such as are still extant in the regions where the specimens were found. It is well, nevertheless, to examine them carefully.

III.

THE IMPORTANCE OF COLLECTING AND PRESERVING FOSSILS.

If intelligent people generally would take a reasonable interest in collecting and preserving fossils, most excellent results would be sure to follow, especially if the fossils were promptly donated to the State museum. Indeed it is very strange that so little is done in this way for the upbuilding of a great collection dedicated to the use of the people. The State Geologist can accomplish but a small part of what could be effected if he had the hearty help of active and intelligent men and women all over the State, who would send him the results of their work done in leisure moments. While it is true that a large number of the fossils taken by any collector will be practically without any value, it is also true that now and again something new, instructive and sometimes very valuable will turn up. It is a common and very foolish mistake to imagine, however, that money can be made by collecting fossils for sale. The sooner this notion is cast aside the better for everybody. The only worthy reward to which the collector can look forward is the satisfaction of knowing that he has done something to aid in the general advance of scientific investigation, and that he has thereby added something to a study which will widen the scope and enlarge the powers of our civilization. The collecting of a great museum of organic remains for our State should be a matter of interest and pride to every good citizen, and it is to be hoped that in the future more will be done to help in the matter than has yet been thought worth while. A great many small private collections exist all over the State; these are quite worthless, save as curiosities, to their owners, while if they were donated to the State and properly set up in the museum they would become for all time the source of education and profit to all the people of the great commonwealth. This is especially true of the relics of prehistoric men—the flint, copper, bone and pottery implements and ornaments found here and there all over the State. Such collections, while they are cumbersome, inartistic and quite out of taste and place in a private house, are the fitting furniture of a great popular museum. Their only value is in connection with a public exhibition which should be as permanent as the government itself, and to this all private collections should be promptly and willingly donated.

IV.

HOW TO COLLECT FOSSILS.

The chief thing in the makeup of a successful collector is a pair of good eyes, the next thing is a habit of close and accurate observation, then comes a knowledge of the great value which may attach to the very simplest objects in nature, and finally perseverance.

Singularly enough, a prejudice exists in the minds of people against the collector; by them he is looked upon as a harmless but misguided "crank" wasting his life on a pursuit too utterly unprofitable to be worth the notice of intelligent and energetic manhood. This is chiefly because the objects and the remote results of science are not palpable, present things, subject to the immediate test of popular experiments. On account of this well-known prejudice many persons who otherwise would devote much time to observing and collecting can not muster up courage to face the current of vulgar comment. The writer of this paper only a few days ago was accosted by a man who saluted him thus: "Hello! nosin' round 'mongst the dornicks, eh! Findin' many periwinkles these days? How much are ye a givin' for snail-shells an' injin flints now?" Here was a different phase of the same spirit which formerly made martyrs of all investigators. The collector and student of nature must expect that he will meet this spirit, and unless he be able to meet it cheerfully and as a matter of course, he will be sure to accomplish very little. On the other hand, however, he will find many friends and helpers; men and women who, unable or unprepared to give attention to science, are still willing and anxious to offer every aid in their power to make the way easy for those who are devoting their lives to the work of collecting the facts upon which knowledge is based.

The tools of the collector are few and very simple. A good steel hammer with a rather long poll at one end and an edge at the other is the most important; it should have a strong but slightly elastic helve about twelve inches long, and may be carried in one's pocket. This is to be used in breaking the stones and in extracting fossils where it may be done without very careful work. A small cold chisel of very hard and tough steel is very useful in taking out delicate fossils where it is necessary to cut round them with great care and caution. Armed with these two simple implements a fairly expert person can be very successful in obtaining specimens of all the organic forms discoverable in outcropping rocks. Of course, when excavation becomes necessary the usual quarrymen's tools must be used. A basket for carrying collected specimens is very handy.

One thing most often overlooked by even expert collectors is to keep a perfect record of the place and the rock in which each specimen is found. This should never be neglected for a moment. Always carry a book and a pencil for the purpose, and so soon as a specimen is taken, make a careful descriptive note of the fact together with an account of the surroundings; then mark each fossil to correspond with the entry in your book; by this means all mistakes may be avoided. Without such a record a collection may be almost useless.

When a collection is being made for private purposes the collector can confer a great favor upon the State, and at the same time add value to his own fossils by sending duplicates to the State Geologist, who will take

great pleasure in assisting in their identification, both for the collector and the State Museum. Private collections donated to the State will be labeled with the donor's name and thus become a permanent monument to his public-spirited and liberal act. Of course it is quite impossible for one not an expert to know much about the interest or the scientific value of what he may collect, but he will always find men of science ready and anxious to give him every aid in their power. If intelligent people generally could be induced to take a fair interest in building up a great State Museum we should soon succeed in the work. A magnificent foundation is already laid, and no room in the State Capitol is more visited or better enjoyed by the people of the State. It is to be hoped that greater interest than has been heretofore manifested may be taken in this subject.

V.

FOSSIL BEDS OF INDIANA.

No State in the Union has greater or more varied fossil beds than has Indiana. From the Ohio River to as far north as the stratified rocks are found outcropping most interesting deposits, rich in remains of both animal and vegetable organisms, have been worked with great success by collectors and learned explorers. Ever since the days of Owen and Lyell the rocks of Indiana have demanded and received the attention of the best paleontological experts, but not until within the last twenty years have the strata generally been cut in every direction by railroads to an extent that has rendered their contents easily approachable by the collector. Along with the advance of great internal improvements in the State, science and scientific methods of investigation have been making rapid progress. The common school system, the enterprise and learning of our newspaper and magazine publications, the liberal and enlightened policies of our pulpits and our colleges, and more than all, perhaps, the restless, inquiring, investigating spirit of our people have pushed forward the study of every material interest, and this has forced the study of geology and its kindred sciences upon us as a matter of practical importance. Consequently, all the best known and richest fossil beds as yet discovered in Indiana have been pretty thoroughly explored and studied by very competent men. The coal-measure fossils of Indiana, especially the vegetable forms, have had the least attention, while those of the Lower Silurian, the Niagara group and the Keokuk shales have become most widely known. Certain coral forms of the Devonian formation, however, have been most thoroughly studied and figured. The black shale of the Devonian has not had due attention, its fossils being of very rare occurrence, and so few of them have been found that there is yet room for doubt as to the rock's geological identity. To this shale the enthusiastic student may turn for investigation, with a chance to win his spurs in science by collecting a suite of

fossils, from which the deposit can be certainly placed. It is not to the famous fossil mines that one must go for something new, but to those as yet undiscovered. Still, for the information of persons interested in collecting for museums and colleges, it may be well to call attention to a few of the richest deposits in the State, with some descriptive notes of a general character.

SPERGEN HILL.

This famous deposit of sub-carboniferous fossil forms is in Washington County. The rock in the "hill" is cut up by the L., N. A. & C. Railroad, and is exposed in heavy masses of easily disintegrated limestone, which weathers to dark reddish clay, leaving well preserved fossils comparatively free from adhering matter. This railroad cut, known as the "Spergen Hill cut," is east of Salem about five miles, and within fifteen minutes walk of Harristown. The rock is the lower bed of the St. Louis group, and is usually called the "Warsaw Bed." Beginning on page 138 of the Fifteenth Report of this Department, the reader will find a list of the fossils taken from this bed; it was carfully prepared by Prof. S. S. Gorby, who made an able report of the geology of Washington County. In the Twelfth Report of this Department, made by Prof. John Collett, may be seen excellent figures and descriptions of a great many Spergen Hill fossils, from which sufficient information may be had to enable any intelligent person to identify nearly all the more common forms. It might as well be admitted, however, that the Spergen Hill beds seem to have been practically exhausted; but, doubtless, there are other places where the same fossils are quite as plentiful, and where new forms might be found associated with them. At least it is well worth while to look for new beds.

THE WALDRON FOSSIL BED.

All over the enlightened world the shales of Waldron are familiar to students of paleontology. This deposit outcrops along Conn's Creek, in Shelby County, and in many places over a small area, including a part of Rush County. It is a laminated, friable so-called "soapstone," consisting of clayey shales and partings supposed to clearly mark the dividing line between the Upper Silurian and Devonian formations. Nowhere in the world has there been found a more interesting and productive bed of rarely preserved fossils of the upper Niagara rocks than that of Conn's Creek. The rock is of a blue or grayish blue tinge, rapidly weathering to a rusty yellow, and crumbling when exposed to the atmosphere. In places it is a mass of fossils whose forms have been retained with remarkable nicety after showing the minutest details of structure. Some of them are of grand size, notably species of *gyroceras* and *orthoceras*, whilst others show forms of exceeding delicacy and beauty.

Professor Hall, of New York, has described a large number of these, many of which will be found figured and described in the Eleventh Report of this department, then directed by Prof. John Collett, State Geologist, whose work has been of great value to science and to the people. Not a few of the so-called Waldron fossils remain yet unfigured and undescribed, offering to the ambitious student a beautiful field for original work.

THE LOWER SILURIAN BEDS.

These are so common in the area of Hudson River outcrop that no description is necessary. A great many fine specimens are taken in the vicinity of Richmond, and thence southward fossil deposits are numerous to the Ohio River banks.

DEVONIAN BEDS.

Near the falls of the Ohio River, at Jeffersonville and New Albany, the coral forms of the Devonian rocks are found in most perfect preservation. Prof. Davis, of Louisville, and Mr. George K. Green, of New Albany, have done a great deal to bring before the world these magnificent fossils. Specimens of grand size and so preserved as to show every line of the beautiful and delicate coral structures have been sent to all the principal museums of the world. Prof. Davis has photographed, figured and described these in a great work soon to appear and for which the world of science will be under lasting obligations to him. As a preliminary study to this work the student would do well to visit the great Devonian coral beds.

COAL-MEASURE FOSSILS.

The fauna and flora of the coal-measure rocks have not had due study in Indiana. Prof. Collett, it is true, did all in his power, and Prof. Cox made every exertion during the necessarily cramped and rapid survey of the coal fields, but the money and time at command could not permit them, or either of them, to make that minute and leisurely examination which alone can afford valuable results in paleontology. The work of the present State Geologist has been entirely outside of the coal-measures area and consequently nothing in this field could be done by him. For plant species the collector in the coal-measure rocks may look in the shales above and in the fire-clays below the seams of coal, with most confidence, but often beautiful remains are found in the sandstones and limestones between the seams, especially where they are of a shaly nature. The animal remains are mostly found in the harder rocks and often in clay and iron nodules or concretions which when split open disclose the fossil. Some very beautiful plant impressions are also found in these concretions. In Vermillion, Fountain,

Clay, Vigo, Daviess and Sullivan counties, and from there southward to the Ohio River, are outcroppings of the coal-measure rocks from which characteristic fossils may be taken, and this is the most interesting and promising field left to the energetic collector. In this field a few insect remains may be found, as indicated by a few specimens from Orange County. In Tippecanoe County some sub-carboniferous fossils (very interesting as throwing light probably upon the earlier forms of a few coal-measure fossils) have been taken by Professor Gorby, but they are not yet figured.

WATER LIME (LOWER HELDERBERG) BEDS.

The survey of the State is just now at the point of examining and studying this important group of rocks, and as yet the fossils therein have not been sufficiently compared and classified to admit of detailed report. Professor Gorby and the writer of this, together with the State Geologist, have traced these rocks almost across the State from east to west, and have found the deposit of varying thickness and composition, but always bearing the general characteristics of the water lime wherever found. Usually it occurs in thin layers of bluish colored impure limestone, but at times it tends to become grayish and more compact. In the gas wells of the northern part of the State the drill passes through this formation, and, owing to the thickness there of the Niagara limestone, some geologists have made the mistake of supposing that the water lime is of unusual depth, when in fact it is not. The Niagara rocks of middle and northern Indiana have been greatly disturbed and lifted, and this has given rise to many untenable theories, among which that of the great thickening of the water lime rock is the chief. Professor Gorby, who certainly has had the best opportunity to study the formation, will soon make a most interesting and authoritative report touching the water lime group in Indiana. Meantime, the attention of geologists and collectors is called to this field with the hope that all the information possible may be gathered by this department on a subject which is very important from both the scientific and the economic point of view. As the drillings from gas wells are very unreliable and rarely contain perfect fossils, careful studies of all the outcrops of water lime will be of prime interest. The State Geologist will deem it an especial kindness if any collector will send to the office fossils found in this formation in Indiana, accompanying each with a definite description of the place and the rock wherein it was found.

KEOKUK CRINOID BEDS.

Perhaps the most famous crinoid beds in the world are those in the bank of Rock River (or Sugar Creek), near Crawfordsville, in Montgomery county. In the report of this Department for 1875, Prof. John Col-

lett, then Assistant to the State Geologist, made a list of the fossils found in that bed so far as they had been figured and described at that time, but since then considerable additions have been made. As the crinoids are the most interesting, a corrected list of them is appended to this paper; it is furnished by Mr. Charles Beechler, to whom I am greatly indebted.

The history of the Crawfordsville crinoid bed is curious, and tends to show how slow have been the movements of science in the West.

The first specimen, an *Actinocrinus*, was found by Prof. E. O. Hovey, of Wabash College, in 1842. One of the finest specimens ever found was an *Onychocrinus exculptus*, which appeared in the Scientific American of July 12, 1887. Between 1842 and 1875, a period of thirty-three years, the beds were worked now and again by different persons. O. W. Corey, of Crawfordsville, a man without training in science, did a great deal toward developing the wealth of the deposit. Prof. Bradley, who was working at one time for Prof. Hovey, of Wabash College, made known to Prof. Marsh, of Yale College, the extent and importance of the beds, and was employed to make a collection for the latter institution, which he did. A fine collection of specimens was sent to the British Museum by Mr. Charles Dyer, of Cincinnati. Professor Hovey made large collections, but there was no detailed local study made which could be called authoritative; the specimens were sent to this, that and the other supposed authority to be passed upon, and very soon no little confusion prevailed in classfication and nomenclature.

From 1858 (in which year two specimens were named—one by Hall and one by Lyon and Cassidy) to 1881, thirty-two species now known to have been found in these beds had been named. Through the steady industry of Professor Hovey, Wabash College slowly drew into her museum a very fine cabinet of crinoid forms, some of which are extremely rare, but a far greater number of the choicest fossils found their way to distant States and to alien countries. Few of the educational institutions of Indiana have secured even a fair collection of these beautiful and instructive remains.

The beds appear low in the bluffs of Sugar Creek (Rock River) underlying a heavy and impure sandstone. The fossils are imbedded in a bluish gray shale which is variably silicious, soft when first exposed, but soon hardening into a refractory state, which renders the specimens difficult to clean if not attended to at once.

Recently Mr. Charles Beechler, to whom I am so much indebted, has been working the beds successfully for Professors Wachsmuth and Springer, whose studies of crinoids are, perhaps, the most thorough in existence, and whose collections are among the best and most extensive to be found anywhere.

*CORRECTED LIST OF FOSSILS FOUND AT CRAWFORDSVILLE, IND.

BY CHARLES BEECHLER.

PORIFERATA.

1884. *Cleodictya gloriosa*, Hall, 35th An. Rep. N. Y. Mus., page 479.

1884. *Cleodictya? mohri*, 35th An. Report N. Y. Museum, page 479.

1881. *Dictyophyton cylindricum*, Whitfield, 35th An. Rep. N. Y. Mu., page 475.

1882. *Ectenodictya (Phragmodictya) eccentria*, Hall, 35th An. Rep. N. Y. Mu., page 476, pl. 20, fig. 1.
Lyrodictya romingeri, Hall, 35th An. Rep. N. Y. Mu. page 476.

1881. *Phragmodictya (Dictyophyton) catillaforme*, Hall, 35th An. Rep. N. Y. Mu., page 477, pl. 21, figs. 1—6.

1882. *Phragmodictya lineata*, Hall; 35th An. Rep. N. Y. Mu., page 478, pl. 21, fig. 8.

1884. *Phragmodictya patilliformis*, Hall; 35th An. Rep. N. Y. Mu., page 478.

1884. *Physospongia alteranta*, Hall; 35th An. Rep. N. Y. Mu., page 481, pl. 20, figure 9.

1884. *Physospongia colletti*, Hall; 35th An. Rep. N. Y. Mu., page 480, pl. 20, figure 7.

1882. *Physospongia dawsoni*, (Whitfield) Hall; 35th An. Rep. N. Y. Mu., page 479, pl. 20, figs. 4, 6, 8.

CŒLENTERATA.

[Several specimens of the genus *Zaphrentis* have been found at this locality, but no definite species have yet been determined except in one case; Ind. Geol. Rep. 1875, gives *Zaphrentis dalli* Edwards and Haime, also the species *Aulopora gigas*, Rominger, *Amplexus fragilis*, White and St. John, *Syringopora* (sp.?)]

*Part of this list was published in the American Geologist, December, 1888.

ECHINODERMATA.

CRINOIDEÆ.

Species marked with an * are referred to said genus for the first time by Charles Wachsmuth and Frank Springer in their work on the revision of the Palæocrinoidea from which this list of crinoids has been compiled.

1881. *Agaricocrinus springeri*, White. Geol. Rep. Ind., 1881.

*1868. *Barycrinus herculeus*, Meek and Worthen. (*B. hoveyi* var. *herculeus*) Proc. Acad. Nat. Sci., Phila., p. 341. Geol. Rep., Ill., vol. v, p. 485, pl. 13, fig. 2.

1861. *Barycrinus hoveyi*, Hall. (*Cyathocrinus hoveyi*) Desc. New Pal. Crin. p. 5, Bost. Jour. Nat. Hist., p. 293. Meek and Worthen, 1873, *B. hoveyi*, Geol. Rep. Ill., vol. v. p. 486, pl. 13, fig. 1.

*1859. *Batocrinus indianœnsis*, Lyon and Casseday. (*Actinocrinus indianœnsis*) Amer. Jour. Sci. and Arts, vol. xxix, p. 75. Meek and Worthen, 1873. *Actinocrinus indianœnsis*, Geol. Rep. Ill., vol. v, p. 341.

*1880. *Batocrinus wachsmuthi*, White. (*Actinocrinus wachsmuthi* not *A. wachsmuthi* 1862—*Actinocrinus scitulus.*) Author's Edit. from 12th Annual Rep. U. S. Geol. Surv. by Hayden, p. 162, pl. 40, figs. 1 a. b. Geol. Rep. Ind., 1879–80, p. 142, pl. 7, fig. 6.

1869. *Calceocrinus bradleyi*, Meek and Worthen. Proc. Acad. Nat. Sci., Phila., p. 73, also 1873 Geol. Rep. Ill., vol. v, p. 502, pl. 14, fig. 9.

1868. *Catillocrinus bradleyi*, Meek and Worthen. Proc. Acad. Nat. Sci., Phila., p. 342; also 1868, Geol. Rep. Ill., vol. v, p. 504, pl. 14, figs. 10 a. b.

1865. *Cyathocrinus arboreus*, Meek and Worthen. Proc. Acad. Nat. Sci., Phil., p. 160; also Geol. Rep. Ill., vol. iii, p. 520.

1879. (?) *Cyathocrinus harrisi*, S. A. Miller. Jour. Cin. Soc. Nat. Hist., vol. ii, pl. 15, fig. 2.

1869. *Cyathocrinus inspiratus* (?), Lyon, Trans. Amer. Philos. Soc., vol. xiii, p. 457, pl. 27, fig. k.

1859. *Cyathocrinus multibrachiatus*, Lyon and Casseday. Amer. Jour. Sci. vol. xxviii.

1870. *Cyathocrinus poterium*, Meek and Worthen. Proc. Acad. Nat. Sci., Phila., p. 24. Geol. Rep. Ill., vol. v, p. 489, pl. 12, fig. 4.

1860. *Dichocrinus ficus*, Casseday and Lyon. Proc. Amer. Acad. Arts and Sci., vol. v, p. 24; Meek and Worthen, 1873; Geol. Rep. Ill., vol. v, p. 500, pl. 14, fig. 1.

1860. *Dichocrinus polydactylus*, Casseday and Lyon. Proc. Amer. Acad. Arts and Sci., vol. v, p. 20.
Syn. *D. expansus*, Meek and Worthen (not De Kon. and Leh., 1853.) Proc. Acad. Nat. Sci., Phila., p. 344; also Geol. Rep. Ill., vol. v, p. 500, pl. 14, fig. 1.

1858. *Forbesiocrinus Wortheni*, Hall. Geol. Rep. Iowa, vol. i, pt. 2, p. 632, pl. 17, fig. 5.

*1859. *Ollacrinus tuberosus*, Lyon and Casseday. (*Goniasteroidocrinus tuberosus* and type of that genus.) Amer. Jour. Sci. and Arts, vol. xxviii, (ser. 2) p. 233; Wachsmuth and Springer, Proc. Acad. Nat. Sci., Phila., p. 263.

1859. *Onychocrinus exsculptus*, Lyon and Casseday. (Typical species.) Amer. Jour. Sci., vol. xxix, p, 78.
Syn. *Onychocrinus* (*Forbesiocrinus*) *norwoodi*, Meek and Worthen. Geol. Rep. Ill., vol. ii, p. 245, pl. 18, fig. 3.

*1859. *Onychocrinus ramulosus*, Lyon and Casseday. (*Forbesiocrinus ramulosus*, L. and C. not Hall.) Amer. Jour. Sci., vol. xxviii, p. 235.

1865. *Platycrinus hemisphericus*, Meek and Worthen. (*Pleurocrinus.*) Proc. Acad. Nat. Sci., Phila., p. 162; also Geol. Rep. Ill., vol. iii, p. 466, pl. 16, fig. 9, and vol. v, p. 16, fig. 6 a. b. c.

1870. *Poteriocrinus* (*Pachylocrinus*) *concinnus*, Meek and Worthen. (*Pot.* [*Zeacrinus*] *concinnus.*) Proc. Acad. Nat. Sci., Phila., p. 26; Geol. Rep. Ill., vol. v, p. 490, pl. 14, fig. 3.

1869. *Poteriocrinus* (*Scaphiocrinus*) *coreyi*, Meek and Worthen (not *Pot. coreyi* Worthen. Geol. Rep. Ill., vol. vi, p. 514.—*Pot. Scytalocrinus grandis*, W. and Sp.) Proc. Acad. Nat. Sci., Phila., p. 148; Geol. Rep. Ill., vol. v, pl. 15, fig. 1.

*1870. *Poteriocrinus* (*Decadocrinus*) *depressus*, Meek and Worthen. (*Scaphiocrinus depressus.*) Proc. Acad. Nat. Sci., Phila., p. 27; Geol. Rep. Ill., vol. v, pl. 14, fig. 8.

1878. *Poteriocrinus* (*Scaphiocrinus*) *gibsoni*, White. Proc. Acad. Nat. Sci., Phila., p. 31.

*1879. *Poteriocrinus* (*Scytalocrinus*) *grandis*, Wachsmuth and Springer. (Described *Poteriocrinus coreyi*, Worthen 1875.) Geol. Rep. Ill., vol. vi, p. 516, pl. 29, fig. 2, 3, (not *Pot.* [*Scaphiocrinus*] *coreyi*, M. W. 1869.)

1878. *Poteriocrinus* (*Scaphiocrinus*) *gurleyi*, White. Proc. Acad. Nat. Sci., Phila., Pa. 32.

1865. *Poteriocrinus* (*Scytalocrinus*) *indianæsis*, Meek and Worthen. Proc. Acad. Nat. Sci., Phila., p. 155; Geol. Rep. Ill. vol. iii, p. 515, pl. 20, fig. 4.

1861. *Poteriocrinus nodobrachiatus*, Hall. Desc. New Pal. Crin., p. 8; Bost. Jour. Nat. Hist., p. 614.

1861. *Poteriocrinus* (*Scytalocrinus*) *robustus*, Hall. Desc. New Pal. Crin., p. 7; Bost. Jour. Nat. Hist., p. 315.

*1879. *Poteriocrinus* (*Pachylocrinus*) *subæqualis*, Wachsmuth and Springer. (Type of the group described by Hall, 1861, as *Scaphiocrinus æqualis*, not *Pot. Scaphiocrinus æqualis*. Hall, 1859.) Desc. New Pal. Crin., p. 8. Bost. Jour. Nat. Hist., p. 316. Meek and Worthen, 1873, Geol. Rep. Ill., vol. 5, pl. 15, fig. 6

1861. *Poteriocrinus* (*Scaphiocrinus*) *unicus*, Hall. Desc. New Pal. Crin , p. 8; Bost. Jour. Nat. Hist., p. 313; Geol. Rep. Ill., vol. v, pl. 15, fig. 5.

*1858. *Taxocrinus multibrachiatus*, Lyon and Casseday. (*Forbesiocrinus multibrachiatus.*) Amer. Jour. Sci., vol. xxiii. Labeled in most American collections, *Forbesiocrinus meeki*, Hall.

*1861. *Vasocrinus lyoni*, Hall. (*Cyathocrinus lyoni*, type of the genus.) Desc. New Pal. Crin., p. 5; Bost. Jour. Nat. Hist., p. 298, 1868, Meek and Worthen (*Barycrinus lyoni*); Proc. Amer. Acad. Nat. Sci., Phila., p. 340.

Syn. *Cyathocrinus hexadactylus*, Lyon and Casseday, 1859. Amer. Jour. Sci., p. 74.

BLASTOIDEÆ.

1858. *Penetremites wortheni*, Hall. Geol. Surv. Iowa, p. 606; also Geol. Rep. Ill., vol. v, p. 606, pl. 15, fig. 1.

ECHINOIDEÆ.

PERISCHOECHINIDÆ.

1868. *Lepidesthes coreyi*, Meek and Worthen. Geol. Rep. Ill , vol. iii, p. 525.

1878. *Lepidesthes colletti*, White. Proc. Acad. Nat. Sci., Phila., p. 33, 1880. An. Rep. U. S. Geol. Surv. Ter. for 1878, pt. 1, p. 163, pl. 40, fig. 2; 1881, Ind. Geol. Rep., p. 362, pl. 41, fig. 2, 2.

ASTEROIDÆ.

1868. *Onychaster flexilis*, Meek and Worthen. Geol. Rep. Ill., vol. iii, p. 526; also vol. v, p. 510, pl. 16, fig. 3.

1869. *Protaster gregarius*, Meek and Worthen. Proc. Acad. Nat. Sci., Phila., p. 169; Geol. Rep. Ill., vol. v, p. 509, pl. 16, fig. 5.

EDRIOASTERIDÆ.

1868. *Agelacrinites* (*Lepidodiscus*) *squamosus*, Meek and Worthen. Proc. Acad. Nat. Sci , Phila., p. 357; Geol. Rep. Ill., vol. v, 513, pl. 16, fig. 1.

MOLLUSCA.

MOLLUSCOIDEA.

BRYOZOA.

1857. *Archimedes owenana*, Hall. Proc. Amer. Asso. Adv. Sci., vol. x.
1858. *Archimedes reversa*, Hall. Geol. Rep., Iowa.

BRACHIOPODA.

1861. *Productus magnus*, Meek and Worthen. Proc. Acad. Nat. Sci., Phil., p. 142; also Geol Rep. Ill., vol. iii, p. 528, pl. 20, fig. 7 a. b. c.
1809. *Productus punctatus*, Martin. Petrif. Derb.
(?) *Productus-semi-recticulatus*, Martin. Ind. Geol. Rep., 1880, p. 125, fig. 123.
(?) *Productus cora*, d'Orbigny. Voyage dans l'Amerique dele Meridionale. Ind. Geol. Rep., 1883, p. 125, pl. 26, fig. 1, 2, 3.
1870. *Spirifer fastigatus*, Meek and Worthen. Proc. Acad. Nat. Sci., Phil., p. 36; also Ill. Geol. Rep., vol. vi, p. 521, pl. 30, fig. 3.
1858. *Spirifer keokuk*, Hall. Geol. Rep., Iowa, vol. x.
1809. *Terebratula sacculus*, Martin. Petrif. Derb.

LAMELLIBRANCHIATA.

1866. *Aviculopecten indianœnsis*, Meek and Worthen. Proc. Chi. Acad. Sci., vol. i, p. 14; also Ill. Geol. Rep., vol. iii, p. 532, pl. 19, fig. 6, a. b.
1865. *Lithophaga? lingualis*, Meek and Worthen. Proc. Acad. Nat Sci., Phil., p. 245; Ill. Geol. Rep., p. 536, pl. 19, fig. 1, 2.

GASTEROPODA.

1860. *Platyceras equilatera*, Hall. Supplementary sheet to vol. i, pt. 2, Iowa Rep , p. 1; also Ill. Geol. Rep. vol. v, p. 518; also Ind. Geol. Rep., 1880, p. 514, pl. 17, fig. 2.

PTEROPODA.

1865. *Conularia sub-carbonaria*, Meek and Worthen. Proc. Acad. Nat. Sci., Phila., p. 253; also Ill. Geol. Rep., vol. v, p. 520, pl. 19, fig. 4.
1859–60. *Conularia crawfordsvillensis*, R. Owen. Ind. Geol. Rep., 1859–60, p. 364, fig. 9.

ARTICULATA.

1870. *Phillipsia* (*Griffithides*) *bufo*, Meek and Worthen. Proc. Acad. Nat. Sci., Phila., p. 52; also Ill. Geol. Rep., vol. vi, p. 528; also Ind. Geol. Rep., 1880, p. 515, pl. 4, fig. 5.

(The above is Mr. Beechler's list, and it is probably the nearest correct of any in existence.)

The writer of this paper has knowledge of another fine crinoid bed near Crawfordsville, but the owner and discoverer is not willing that its location shall be made public.

THE CHESTER GROUP PLANT BEDS.

In the coarser sandstones of the Chester group of rocks in Indiana are found many interesting vegetable remains, which have not yet been thoroughly studied. The eastern tier of the southwestern counties of the State offer here and there an outcropping of these rocks. These were examined by Professor Cox and Prof. John Collett, but owing to the hurried nature of the survey made, little was done in the way of collecting a complete suit of Chester plant fossils for the museum. The attention of students and the friends of science in that part of the State should be directed to this need of the Department, and it is hoped that the museum will soon receive specimens from this group of rocks. If the discovery of available beds of fossils were reported to the State Geologist it would greatly facilitate the work of filling up the cabinet, even if collectors should still continue to withhold their aid with the hope of making a paltry gain in money by selling their collections to parties outside of the State.

PLANT REMAINS OF THE DRIFT.

The Department museum is in possession of a limited cabinet of plant remains found in the drift deposits of the State. These are chiefly bits of wood taken from wells and other deep excavations. Vegetable mould, the decayed remains of leaves and twigs are quite often met with by well diggers below heavy deposits of bowlder clay. Such things are interesting and valuable for comparative study, and the Department is always glad to receive them. One of the obscurest and at the same time one of the most important questions connected with the past history of the earth may yet have great light thrown upon it by a minutely painstaking investigation of all the discoverable facts connected with the body of our drift deposits, and none of these facts is more burdened with valuable suggestions than the presence of vegetable remains intercallated between the solid beds of bowlder till. If each person who chances to observe such remains will but take the small pains to record all the surrounding conditions and to write a succinct description of the place where the dis-

covery is situated, with all the attending features, we shall soon be in possession of most convincing evidence of the real truth concerning this great drift mystery, in one regard at least. Plant life is a sort of index to climate and to physical conditions on the earth's surface at any given time and place. If we can discover what manner of vegetation flourished at the coming on of a glacial era in the history of Indiana, we can describe with tolerable accuracy the climate and the soil in which such plants grew and thrived. If forms of vegetation known to be confined to tropical regions were found buried in our drift masses we should know at once that these forms had been grown in a climate far different from that now prevailing here. On the same principle boreal plant forms would tell of a frigid temperature prevailing in what is now a temperate area. Of course these suggestions are trite to the man of science, but to the average citizen for whom this report is mainly written, it is necessary that they should be presented in order that he may have a general idea of the value attaching to what may at first sight appear very simple and even very foolish investigations. It was well said that "knowledge is power," and often enough the knowledge which is greatest power comes out of circumstances as slight as the steam lifting the lid of a tea-kettle, or the falling of an apple from a bough.

The best points at which to search for drift plant fossils are to be found in deep railroad cuts, in the blue-clay bluffs of streams, and in the excavations of cisterns, cellars and wells. Any ancient bits of wood or other vegetable matter found in such places should be carefully preserved and have the examination of an expert. The State Geologist will always be glad to have them.

FOSSIL BONES, ETC.

A great many very interesting animal remains have been found in the post-glacial deposits of Indiana. These have been chiefly the fragmentary skeletons of animals now extinct, and mostly species of giant size, like the ancient elephants, sloths, tapirs and beavers. The habits and lives of these great and forever extinct beings are not yet understood, nor are the circumstances which brought about their extermination at all clear to even the most advanced students of nature. In the fourteenth report of this department Professor John Collett, State Geologist, presented a paper by Professor E. D. Cope and J. L. Wortman, in which the student will find a comprehensive guide to a beginning of this study, and a far more compact and condensed presentation of the same subject appears in the fifteenth report by the present State Geologist, Maurice Thompson. The figures in the fourteenth report and the description in both the fourteenth and fifteenth reports, will enable the ordinary collector to satisfy himself with reasonable certainty as to the probable value of any remains he may find.

Partial skeletons of the mammoth and the mastodon are the most common discoveries in our post-pliocene deposits, and, as I have already remarked, there is much yet to be learned from a close and detailed study of them. The fact that these remains are rarely found elsewhere than in marshy places where the animals appear to have perished in the mire of sloughs or bogs, has given rise to much speculation, but as yet no theory entirely satisfactory has been adduced. Vast numbers of teeth, jawbones and other more or less fragmentary parts of these colossal skeletons have been discovered by ditchers, and have been cast aside to fall to pieces under the action of the atmosphere. The State Museum has a very inadequate collection of such remains, and it is hoped that with a growing knowledge of science and an increased interest in the building up of a great center of study, the people will aid the department in procuring a large cabinet of specimens. Little, indeed, can be done without such aid freely and generously given.

RECENT AND CONTEMPORARY FOSSILS.

The museum of this Department has a large and most valuable collection of land and fresh water shells, most of which belong to existing species. These are scarcely to be classed with fossils proper, or even with what have been named sub-fossil forms; but many specimens of both land and fresh water species are to be found, well preserved, in the recent river and stream terraces, and in the cracks and crannies of our outcropping rocks, as well as in the loams and moulds of our woods and fields. The collecting of these forms has been followed very successfully by quite a number of enthusiastic persons in Indiana, but much still remains to be done. The older fresh water shells, such as are found in the loess or lacustral deposits, are of great interest, and specimens will be gladly received by the State Geologist. The southern and southwestern counties of Indiana have many of their hilltops capped with lacustral sediment, in which many new forms, doubtless, may be found. To this special field not enough attention has been given. A careful examination of all our loess and ancient river deposits might result in a considerable advance of our knowledge of the later forms of extinct fresh water animals. Moreover the materials of these deposits have not yet been studied sufficiently to make us acquainted with their elements of economic value, a matter well worth consideration.

MICROSCOPIC FOSSILS.

Swarms of infinitessimal animals and plants have passed into a fossil state and are found in the rocks. Many of these minute organisms are barely perceptible to the naked eye, while a still greater number can be seen only by the use of the microscope. The chalk formations of Great Britain are composed of fossil organic forms, named *Foraminifera*, which

are not observable with the naked eye, but which have been carefully studied. So our oolitic limestones of Indiana show under the glass a solid mass of minute shells, which as yet have not been thoroughly examined and described. Indeed it may be said that the infinitessimal fossils of Indiana are practically unstudied, though some intelligent and very commendable work has been done in that direction. The use of the microscope affords a most pleasing and instructive method of studying nature and there is nothing difficult about handling the instrument, in fact for all ordinary purposes a very simple magnifying glass is quite sufficient, and it should be carried with the outfit of every collector and student. No form of life discoverable at all is too small or too simple for study. Every organism is significant as a link in the great chain of animate existence, reaching back into the dark and mysterious past. We can not afford to leave a single one unnoted if we would make the most of our possibilities in the way of tracing the records of that slow development which has brought life up to its present highly specialized and complicated forms.

Nearly all of our sedimentary rocks will be found bearing a number of these minute forms of animal remains more or less perfect and subject to very interesting comparative study with the glass.

Scarcely less attractive to the zealous student are the microscopic vegetable organisms whose traces have been left in the rock formations. The spores of ancient plants and the shells of *diatomaceæ* come out clearly under a powerful microscope, and their study will be found of absorbing interest in connection with the higher botanical problems with which our advanced thinkers are at present busying themselves. Especially is it desirable to have the attention of investigating minds directed to a careful microscopic examination of the coal-shales, the fire-clays (and the coal itself) of all our coal-seams with a view to a settlement, if possible, of the question of their origin. It has been claimed by geologists of high authority that vegetable tissue and the spores of various plants have been found in the body of bituminous coal. If this can be well settled as true, it will go a long way toward proving the vegetable origin of our coal deposits. At the dividing line between the roof shales and the coal proper would seem to be the point where investigation might be best rewarded with discover ies of significance. The impressions of various plant forms in these shales would suggest that the purer and more compact body of the coal proper might, near the dividing line, show traces of the tissues and fibers of those or of other and older forms. We have so many coal seams in Indiana, one above another, and each differing from all the rest as much in quality and character as in stratigraphical position, that it would be a matter of great convenience, from both the economic and the scientific point of view, if we could discover even microscopic fossils by which each seam could be identified so soon as a sample could be examined.

Large deposits of diatomaceous earth, or rock, have long been known at various points in the United States, the most noted being in Virginia. As yet none has been found in Indiana of a quality fit for commercial purposes; but it is not impossible that we may yet be successful in discovering a bed of it. At any rate the field for microscopic work in the rocks of Indiana is a large one, and well worth a great deal of attention.

There is yet another special subject to which the thoughtful and investigating minds of students may turn with profit. The Drift clays have not been properly studied with a view to ascertaining their origin. The writer of this paper believes that the microscope alone can settle this question. It will be found upon examination that a good glass of moderate power will disclose in these clays fragments of fossils from which the original location of the contributing rocks can be determined with approximate accuracy. Maurice Thompson, the present State Geologist, has made a long series of observations in this line upon which he hopes to base a report in the future. Such work is necessarily very slow and its details very minute and tedious. It would be a great saving of time and a constant check upon inaccuracy, if a considerable number of competent persons would join in this very important work, and occasionally contribute their discoveries to this department.

ARCHAEOLOGICAL RELICS AND HUMAN REMAINS.

Properly speaking these relics and remains are fossils, and may be treated as such herein. No ancient forms can be of more significance or more weighted with tantalizing suggestions than the stone, and other implements of the prehistoric races of men. I have already spoken of the curious law of perversity which causes persons to store up these relics as ornaments (?) in their private houses rather than contribute them to the upbuilding of a great State museum in the capitol. If all the stone implements, pipes, pottery, copper relics and bone instruments now scattered over the State in the hands of individuals who can make no scientific use of them were given to this department, it would double the value of the museum, while it would not make the donors one cent poorer. There are yet a few mounds, scattered over the State, which might give good returns to investigation. For a description of these and a clear and succinct history of what is known about the so-called prehistoric races of Indiana, the reader is referred to Professor Gorby's able paper in the fifteenth report of this department.

SUB-FOSSIL REMAINS.

Referring here particularly to the skeletons and skeleton fragments of presently existing animal forms frequently found imbedded in our soils, and especially in our peaty bogs, it may be said that such remains are quite interesting and valuable, and will be gladly received in the museum.

They serve as data from which the natural history of Indiana may be written. At present most of the larger forms, and many of the smaller forms, of wild animals (which formerly lived here) are forever gone from our State, and the only certain guide left for us in making up the faunal lists is found in these fossils, since the memories and traditions of men are notoriously unreliable in matters of natural history. Every bone found imbedded in the soil, muck, peat, sand, gravel or clay should be preserved until it can be examined by an expert comparative anatomist, or it should be sent directly to the State Geologist. In England and France, and, in fact, throughout Europe, the sub-fossil remains have received far more attention than in America. Here, because our country is new and in many parts still infested with most of its original animals, we have neglected to collect and preserve the only sure indices of local faunas. It is already too late to make complete amends for this oversight, but a great deal can yet be done to make clear most of the facts necessary to a complete natural history of recent and contemporary life. Indiana can not afford to be behind in this, and it will be well for the controllers of her educational institutions to take early steps toward attracting the attention of students to a field so full of valuable materials likely to soon disappear forever.

The chief object of this paper is to suggest and stimulate investigation and to impress upon the people of Indiana the prime necessity of popular donations to the State Museum. The Legislature never has furnished the Department of Geology and Natural History with a fund sufficient to warrant the purchase of collections; the extensive cabinets now in the museum represent the work of the State Geologist and his assistants since the beginning of the survey, with the addition of small donations by a few public-spirited men and women who have cared more for the general welfare of the people than for their own narrow curiosity or their hope of being able to sell for a paltry sum the objects of merely scientific interest and value.

A vast museum of Natural History and Geology, open at all times to the public, is a center of study whither flock for investigation and reference all the most active-minded and inquiring students in the Commonwealth. It is a place where a liberal touch is given to intelligence and where the profoundest suggestions of nature present themselves in connection with a vast variety of the most interesting and instructive forms of past and present life. It is not mere dry technical science that offers itself and speaks through these exponents of past ages, if we view them with an enlightened vision. In learning the alphabet of terrestrial life, we build the foundation of a practical and keen perception of what are our present needs and our future possibilities. Broad culture and a high civilization give to a people that sensibility to coming generations which is the dividing line between a christian and a heathen influence; but there can be no broad cul-

ture, no high civilization, in the true sense, where science is viewed with prejudice and where its results are belittle or denied by the directors and controllers of popular sentiment.

The time was when Indiana was looked upon by those outside of her boundaries as a State given over to ignorance and boorishness, but this reputation is rapidly passing away before the effects of popular education and the liberating influence of increasing wealth and almost unlimited means of intercourse with the rest of the world. It is not too much to say that this department has aided in the good work of showing to all lookers-on the many striking advantages possessed by our State in point of richness of soil, value and quality of mineral products and healthfulness and desirability of climate. Beginning with Brown and Owen and coming down with such able and enthusiastic men as Cox and Collett, together with the large number of learned and able assistants, the department has been the faithful and earnest register and annunciator of the State's material progress from its infancy to the present hour. It should certainly have the support of the people, and in no better way can this support be affirmed than by liberal donations to the museum, and prompt and ample appropriations by the Legislature.