

N. J. F. G.

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INDIANA.

DEPARTMENT

-OF-

GEOLOGY AND NATURAL HISTORY.

SIXTEENTH ANNUAL REPORT.

MAURICE THOMPSON,
State Geologist.

EDITED BY S. S. GORBY.

1888.

TO THE GOVERNOR.

INDIANAPOLIS:
WM. B. BURFORD, CONTRACTOR FOR STATE PRINTING AND BINDING.
1889.

THE STATE OF INDIANA,
EXECUTIVE DEPARTMENT.

December 27, 1888—Received, examined by the Governor and transmitted to the Secretary of State for publication, upon the order of the Board of Commissioners of Public Printing and Binding.

PIERRE GRAY,
Private Secretary.

Filed in the office of the Secretary of State of the State of Indiana this January 2, 1889.

CHARLES F. GRIFFIN,
Secretary of State.

OFFICE STATE GEOLOGIST,
INDIANAPOLIS, IND., December, 1888.

TO HON. ISAAC P. GRAY,
Governor of Indiana:

DEAR SIR: Herewith I submit to you the manuscript of the 16th Report of this Department, with a confident hope that it may be found of great value to the people.

I take pleasure in acknowledging here the cordial aid received from you, and I beg to add that my special thanks are due to all the State officers.

During the past fiscal year there has been no appropriation of funds upon which this Department could draw for its running expenses and the salaries of assistants. Hon. J. A. Lemcke, State Treasurer, has kindly furnished the money, for which disinterested liberality he should have the hearty commendation of the people, and the Legislature should promptly reimburse him.

I am happy to state that, although the Department has been very hard pressed, on account of the immense development of our gas field, and the necessary re-arranging, re-labeling and re-classifying of the entire museum, over and above the usual work of the survey, I have been able to keep the expenditures within the bounds of the ordinary appropriation of five thousand dollars per annum, which includes the salary of the Chief of the Department. I respectfully submit the report and remain,

Most sincerely yours,

MAURICE THOMPSON.

ASSISTANTS TO THE STATE GEOLOGIST.

W. H. THOMPSON,
CHAS. R. DRYER,
S. S. GORBY.

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PREFACE.

In his introductory paper Prof. Thompson has mentioned some of the difficulties with which this department has had to contend for the past two years, the principal of which were a vast increase in the amount of work necessary to be done and an embarrassing lack of funds for the successful and satisfactory prosecution of the work. In December, 1888, Prof. Thompson, on account of continued bad health, was compelled to resign as State Geologist, and the writer was appointed by Governor Gray to fill the vacancy. Since that time I have been wholly without means to employ assistance of any kind, and have been compelled to pay all the necessary office and traveling expenses out of my own pocket; and at the time that this report goes to press there are no funds in the State Treasury upon which I can draw for supplies of any kind.

The report, as Prof. Thompson states, has been greatly delayed by causes over which the State Geologist had no control whatever. It was ready for the printer about the time that the General Assembly convened, but the great amount of printing required by the legislative committees kept the printers continually employed, so that the work for this department was necessarily laid aside. The printing of the Acts of the General Assembly then followed, after which the reports of the other departments of State, previously begun, had to be completed, all of which tended to delay the completion of this volume.

Since December 1, 1888, I have had no assistance, either in the office or out of it, and my duties have been most laborious and varied. The supervision of the Museum, correspondence and other office work, occasional field work and details of every kind, in fact, every duty pertaining to the Department I have been compelled to perform myself, for the reason that there were no means to employ assistance. Much of my time, therefore, has been devoted to work that should have been performed by an office boy, or other assistant, and much important work that only the State Geologist can do has, in consequence, been neglected.

Accompanying this report is a map showing the various natural gas areas of the State. Very nearly one-seventh of the State produces natural gas in paying quantities, and the outlines of the areas, as shown by the map, mark the limits of the various fields where gas is found in paying quantities at the present time. Future developments may enlarge these fields, or disclose others in other parts of the State.

The report upon natural gas contains statistical and other facts pertaining to the various industries throughout the gas field, up to November,

1888. Since that time developments in the gas areas have been very rapid. New wells are brought in at the rate of one a day, and capital is being invested at the rate of near half a million dollars per month.

In his reports, of which this is the second, Professor Thompson has mainly endeavored to present the practical side of science. The stone, coal, clay, sand, gas and petroleum—substances of commercial value—have received the most attention. The aim has been to advertise the immense mineral wealth of the State to the fullest extent, rather than to collect facts of a purely technical or scientific nature.

Letters from every portion of the Union, and, in fact, from nearly every country in Europe, are continually pouring into this office, containing inquiries pertaining to our coal, stone, kaolin and other clays; our gas, petroleum and other substances, and, as a rule, these letters are from persons who are seeking locations for the investment of capital in manufacturing, mining or quarrying industries. Many letters are received from persons who desire to purchase material for the erection of buildings, or who are seeking clays to be used in the arts, or for other minerals known or supposed to be found in this State.

Many of the inquiries concerning the stone, or other resources of the State, require long, carefully written replies. The information sought is often very important, and yet so general in its nature that it can not be obtained in any one geological report of the State. And even when the desired information may be found in some particular report, the chances are that the volume can not be supplied from this office, for at this time the entire stock of Reports is exhausted, except a limited number of the fifteenth. To get all the information frequently required, one would have to consult the entire set of Indiana Geological Reports (which is very difficult to obtain), as the State so far has been surveyed by counties in detail, without reference to formations. No one of our reports is devoted wholly to the coal measures, or coal-bearing counties. Neither does any one of them treat exclusively of the stone deposits, so that any one interested either in stone or coal, or any other of the rich mineral deposits of the State, must consult the entire set of Reports to get all the facts that have been published concerning the particular subject he is interested in.

A comprehensive report upon the building stones of this State is greatly needed. This should be embraced in a single volume of convenient size, and should include all the facts of interest pertaining to the various kinds of stone found throughout the State. A single report would then supply all the facts that are now contained in the entire set

So, too, with the coal and other mineral deposits of the State. The whole subject should be embraced in a single volume, carefully prepared; and those who are interested in any particular subject could then secure the facts they desire without having to procure an entire set of Reports, at great expense, and then laboriously examine them all to get the desired information.

S. S. GORBY.

INTRODUCTORY.

In presenting to the people of Indiana the Sixteenth Report of the Department of Geology and Natural History, it is necessary to say that the field work for the period considered has been very greatly retarded by circumstances over which the State Geologist has had no control. The museum had to be transported to its rooms in the State House, and all the specimens of the vast collection had to be re-labeled, re-arranged and re-set in the new cases. This involved an amount of work not to be estimated by those unfamiliar with the tedious and difficult nature of the undertaking. Some two hundred thousand articles have been handled four or five times during the process, to say nothing of the labor of comparing and identifying the organic remains that had not been studied previously, or whose labels had been lost in moving or that needed revision. Hitherto the museum had been kept in rooms quite inadequate to its needs, which had prevented the Department from making a proper study and classification of the fossils. Both Professor Cox and Professor Collett had labored under exceedingly discouraging circumstances, and the amount and value of their work is marvelous when we consider the limitations and restrictions to which they were subjected. Indeed it is one of the greatest pleasures of making this report that I can bear testimony to the energy, efficiency and enlightened spirit of the distinguished scholars who have preceded me in this office in which, all along, have existed those hampering and worrying needs which now render effective work almost impossible. To think of carrying on a study and report of the great mineral interests of Indiana, caring for her Museum and advancing the scientific study of her Geology and Natural History on a basis of five thousand dollars a year, all told, is absurd. To-day Indiana is among the foremost States in the Union as regards mineral wealth. A proper knowledge of this, disseminated throughout the reading world, would give a mighty impulse to the industries, the trade and the commerce of the State. It has been the effort of the Department to make the most of every opportunity to give the public early notice of every discovery of any importance touching Mines, Minerals, Natural History or Geology, and to this end the principal newspapers of Indianapolis have been furnished, from time to time, with such statements in connection with the work in the field as were thought to embody facts of general interest to the people.

During the two years which have passed since the last report was issued from this office the number of letters of inquiry received from all over the world has been very large and constantly increasing. Most of these letters have been from persons desiring information regarding the material wealth of the State or touching the advisability of locating mining, quarrying or manufacturing establishments within our borders. Many inquiries, however, have been of a purely scientific nature, whilst others have been upon subjects connected with the waters of our many and valuable mineral wells and springs. A very large number of the letters received from citizens of the State have been connected with agriculture, soils and fertilizers. The want of a proper laboratory for chemical analyses and other practical scientific tests and assays, is constantly felt, and the State should furnish this to the Department at once. It has been impossible to analyze the gas discovered in the rocks of Indiana, and thus a very important work in connection with this report has been passed by. The citizens of our great State certainly should have a place prepared for them where they could be sure of obtaining the fullest explanation of whatever is for the advancement of their material welfare. There is a growing desire for progress, for enlightened methods and for the scientific application of knowledge, and this is notably true of our agricultural people, who are beginning to discover that wealth and happiness depend largely on trained and alert minds. The time was when farmers were inclined to treat science as something impractical, and scientists as mere visionaries or "cranks;" but that has passed in a measure, as our excellent school system has prepared the way for a better view. Many of our farmers are thoughtful, reading men, anxious to learn and zealous in the pursuit of the culture best suited to their surroundings and mode of life. At least seven-tenths of the persons in Indiana making inquiry for our reports are farmers, while a larger part of the remainder are educators or students in our schools. I have found that the science of geology (in connection with botany and kindred biological studies) is occupying a great deal of space in our educational field, with the result of stimulating practical experiment and careful investigation along many lines of thought.

The notion that the chief end of geological study is to collect fossils and classify them should be driven from the mind of every student. Paleontology has its place of practical utility as a sign language by which the rocks impart their secrets to us, and through which we may reach the significance of things otherwise meaningless; but, upon the whole, the discovery of a ledge of good building stone is more to be prized than a mine of crinoids or a hill full of trilobites, pentramites and the rest. The discovery of the potato was of more value to mankind than all the works of Darwin, Huxley, Tyndall and Agassiz combined. Nor is this belittling these great men. It simply means that though one should

make plain as day the origin of life it would be as nothing compared with a discovery of cheaper food for the poor and shorter hours of labor for the toilers. Abstract study is for the man and woman of leisure; the concrete is for the busy, earnest worker. The greatest good to the greatest number is a maxim which would force the report of a State Geologist into a practical channel; still the larger part of the literature of even popular science must deal with the technical rather than with the untechnical, and we must depend upon the intelligence of the people to enforce a system of education which shall set the popular thought on a level with enlightened investigation. It is by such means that civilization is broadened and bettered year by year. Steam is mere vapor, viewed by itself, but in an engine it is the master of the age. Science, seen in books, is a dry and unpopular literature, but seen in the electrical machines, in the steam-ships, in the mills, the factories and the mines, it is the very vital center of the progressive civilization of the nineteenth century. Many, perhaps the greater number, of our most useful inventions have been discovered by persons unlearned in the sciences, but in almost every case science has perfected what untaught genius has sketched in the rough. The popular mind has begun to grasp the correlations of theory and practice, and it is becoming easier, day by day, to make headway against the prejudice of ignorance. Still there are people in Indiana who trust to "water-witches" to locate wells, and there are others who turn from the man of science to the man who waves a divining rod when opinion is wanted upon the subject of natural gas. Strangely enough, even the most intelligent people, especially when pressed by the excitement of pending or prospective discovery, will give no heed whatever to the teachings of fact, but will turn and follow blindly the suggestions of chance. Evidence of this has not been wanting in the course of the explorations for natural gas. The State Geologist, the moment that a gas reservoir had been pierced in Indiana, began a rapid survey of the field with a view to establishing its probable outlines, thinking by this means to save the citizens of the State many thousands of dollars. In a short time the department was in possession of facts sufficient to make it reasonably certain that the gas area had a definite limit outside of which it would be useless to expend money in boring; but the "experienced well-borers" were listened to in preference to the State Geologist, with the consequence of empty pockets and dry holes. There can be no doubt that several hundred thousand dollars have already been foolishly spent in sinking wells outside the gas limit in this State, and still the boring goes on. This indiscriminate work, however, has had its value to the State in that it has furnished this department with a knowledge of our rock formations which will be of great importance in the near future, and which could not have been obtained in any other way. Furthermore, the popular excitement touching natural gas discoveries has stimulated study and re-

search among our citizens, so that I dare say the people of Indiana have to-day a better practical notion of what geology really is than have the people of any other State in this Union. It is to be hoped that this knowledge will have a wholesome effect in the direction of urging wise and liberal legislation for the dissemination of science.

By far the larger part of the field work of the Department since the issuing of the last report has been devoted to the gas field and to a study of the borings therein. Professor Gorby has had charge of this work over the principal area, and his labors, though greatly interrupted and hindered on account of the necessity of looking after the removing and re-arranging the Museum, have been very thorough and satisfactory, embracing every detail with most interesting results. Necessarily his written report has been curtailed and condensed, as the time which should have been given to it had to be taken up with arduous work in the Museum; but it will be found of practical interest and value to the people, while at the same time it embodies a sketch of all that is known regarding the nature and origin of natural gas with a clear statement of the scientific theories connected therewith. It has been the policy of this Department to give to the Assistant Geologists a free field and a full expression of their views. If the State Geologist, in his own judgment, would modify any of the theories advanced by his able assistants, he does not feel like making these modifications a point of controversy. At best theory is a matter of personal conclusion from an individual point of view, and must be tested by the accompanying facts. The opportunities of the assistants in the field have been ample, and the facts they have gathered have been ably presented. Their opinions are worthy of the very highest consideration, and their statements should be taken as authoritative so far as they go. Professor Gorby is an expert paleontologist, and his labor in the Museum has been invaluable. He has had to handle every specimen in the cabinets, identify every species of the organic remains, label and classify each and arrange all in the cases in due order, while at the same time he has prepared a catalogue of the entire collection. This work has progressed rapidly and is thorough so far as it has gone. Much remains to do, however, before the Museum can be said to be fully arranged. A careful revision of the order and the labeling will be necessary, and all the coal-measure plant-fossils are yet to be classified and labeled. Professor Gorby has been assisted in the Museum by Mr. Callis, whose work has been the cleaning and placing of fossils.

In the field Mr. W. H. Thompson has had charge of most of the geological work in the western division, of which a preliminary partial report is herewith submitted; he has also had charge of the natural gas studies from Frankfort westward. When the survey of the western division shall be completed the report must be one of great interest to the people. The sketch now published is necessarily incomplete in most respects, but

in it will be found many features of value, especially the notes on the botany and the ornithology of the Kankakee Valley. It is expected that these notes are the merest beginning of a full report of the flora and fauna of that interesting region. Mr. Thompson is doing his work in connection with the Chief of the department, and it will require at least two more years to complete it, probably more.

The survey of Allen County, and that of Dekalb County, will be comprehensive and adequate. Professor Dryer has shown great energy and thoroughness, and his reports are excellent, especially in the clearness and conciseness of their descriptions. It is by the localization of scientific studies and by the description of the simplest features that the objects of science are differentiated for the popular understanding. There was a time when the public school system had a host of opponents among the people, but it would be a very small group of Indiana's citizens who would openly attack that system to-day. So it is with opposition to the work of this Department; at first it had many bitter enemies who argued that the pittance allowed by law for its maintenance was money thrown away; but to-day all the enlightened intelligence of the State is supporting it. It is clearly seen that although no startling results have been reached by our investigations, we have been able to disseminate gradually a vast amount of useful information which has stimulated the development of the State's material resources and attracted the attention of capital and manufacture in every part of the world. The Department has received many hundreds of letters from abroad, from England, Germany, Austria, France, Italy, Russia, and Sweden, not to mention the smaller European States, asking for information upon a multitude of subjects connected with mining, agriculture and the investment of money in enterprises within our State. These letters have all been answered at length and with carefulness of detail. The coal, the building stones, natural gas, limestone for making lime and cement, and our various deposits of fire clay, kaolin and potter's clay, our iron ores, our beds of pyrites, glass sand, grit stone, marls and chalk beds, as well as our incomparable fossil deposits (sought for cabinet purposes), have attracted very wide attention, and a tremendous impulse has been given to the development of our resources within the past two years. In all the gas area, many of the fortunately located towns have leaped from obscurity to importance, from mere rural villages to manufacturing centers of considerable proportions. Kokomo, Marion, Anderson, Muncie, Noblesville, and many other prosperous towns have shown a wonderful growth in population and wealth. Indianapolis has experienced a revolution in the matter of fuel, and the future alone can tell what prosperity is to result to her people, and to what proportions she is to grow as the greatest inland city in the United States. Along with this material growth educational growth must go apace if we shall reap

the full benefit of our civilization, for we certainly have reached that age of the world in which it is more necessary than ever before to keep the equilibrium between the public power and the public conscience. Enlightenment in aristocratic countries flows downward from the heights of society; in our country it must well upward from the great plain of the people; in other words, the commonwealth depends upon popular liberality, morality and wisdom. Give the people knowledge and they will take care of the material interests of the country. It is the duty of the State to maintain free fountains of information in order that while the body of commerce and trade is being developed to its fullest power, there may be no lack of a correlative growth and perfection of the public mind, so that our people may avoid the conditions of the old world civilization, which makes necessary a division of the human race into two opposing and unsympathetic elements, the oppressors and the oppressed. This Department has not been controlled in the interest of mere abstract science, its chief views has been the development of Indiana along all the lines of material prosperity. Every effort has been made to encourage inquiry, experiment, investigation and comparison in the light of the most recent methods of science, but at the same time the larger aim has been to enkindle a popular desire for enlightenment upon the practical application of science to the ordinary pursuits of life. Let me insert here an illustration which should make plain my meaning. The board of county commissioners of a certain county in Indiana found it necessary to erect a public bridge over a considerable stream. The structure required expensive stone abutments. With a view to economy the commissioners ordered these abutments to be built of a certain rock outcropping hard by, and which could be quarried easily. The result was that the abutments crumbled down within two or three years, and new ones had to be built at great expense. Now a little science just here would have been very valuable. The simplest test in the world would have shown the quality of the stone used with a great saving to the taxpayers of the county.

This is but one of a thousand instances that might be cited. Popular enlightenment is the great fountain head of economy, thrift and happiness. Ignorance is arrogance, and this means stupid waste of time, energy and money in order to discover what would be obvious from the first to a trained intelligence. But what has all this to do with Geology and Natural History? some one may inquire. Well, Geology and Natural History cover a consideration of the entire field of native wealth in this State. What is agriculture? It is the culture of field plants for the use of man, and Natural History is the history of these plants. What is soil? In the language of Geology it is one of the rocks, therefore this Department studies soils. Whatever is mined from the earth is a subject of Geological inquiry. Whatever lives on or in the earth is treated of in Natural History. So it will be seen that the Legislature in creating the

Department of Geology and Natural History gave to the people an office from which they should receive a broad flood of information. Have they received it? In answer let me point to the development of the coal fields of the State, to the incomparable building stones now going from Indiana to every city in the Ohio and Mississippi valleys, to the iron ores developed, to the clays manufactured into tiles, pottery and alum, and to the inestimable blessing of natural gas. All these, if not due to geological discovery in the first place, have at least had their value and extent made known to the whole world through the reports of this Department. Nor do the printed volumes contain the tenth part of the information imparted to the people. More than five thousand letters of inquiry have been answered by the Chief of Department and his assistants within the past two years. Aside from the letters coming to the office, the State Geologist has received at his home an average of three letters a day, for a large part of each year, which have called for especial attention, oftentimes involving elaborate discussion of scientific subjects and the writing of long and painstaking answers to important inquiries. By such means the Department has been able to do a very widespread and valuable work for the people. Perhaps the best results of these labors have not appeared in a form to be easily pointed out, but any close observer can not fail to note the recent rapid growth of knowledge in Indiana along the lines indicated by the creators of this office. A continuance of the work will be productive of still greater good.

The Museum is now open to the public and is a center of attraction to which swarms of visitors are drawn every day. The educating effect can scarcely be estimated.

Students of our various institutions come to verify, by the light of organic specimens, the teachings of the text-books; teachers come to make special investigations, while whole classes often come together to make the round of the cabinets. Of course a large number of visitors are attracted by mere curiosity, but even these go away with a broader horizon of thought and with a quickened intelligence.

There is a great demand among the people for the reports of this Department, and nearly all the issues from the first to the fifteenth are exhausted. It has been the purpose of the State Geologist to use great care in the distribution so as to have the books go into the hands of those who would make the very best use of them. Farmers, teachers, ministers, manufacturers, miners, quarrymen, persons of enterprise, men of science, public officials interested in the material progress of their counties and districts, investigators, prospectors, indeed, all persons likely to assist the purposes for which the Department was created have been supplied with the reports, besides the regular quota furnished to the Auditor of each county in the State for judicious distribution. Copies have also been sent to the Geological Department of each State, and to that of each foreign

government, as well as to a large number of associations and libraries all over the world. By such means has the work of this Department reached the attention of millions of inquiring minds, with the result of advertising the material wealth and advantages of the State in a way that could scarcely be commanded by any other method. There should be given the Department authority to print and distribute at discretion, within proper financial limits, intermediate reports upon special subjects whenever the public interests call for it. In the case of natural gas, if the State Geologist had been authorized to issue a pamphlet report the information it should have contained would have been of immense value to the people. As it was, the Department was compelled to rely upon the newspapers whose editors kindly offered space for communications giving information to the public. Although a great number of readers could be reached in this way, the result was not what could have been accomplished by a connected and practical intermediate report printed in handy form and distributed free to persons interested in the development of gas wells. The saving to the people upon such a report would have been more than a hundred times its cost.

The catalogue of the Museum will be found very important and useful to students who wish to consult the cabinet, and it is indispensable to the curator. It has been compiled without extra cost to the State, as its construction was a necessary part of the re-arrangement and perfect classification of the specimens. The coal-measure fossils are not all included. Indeed, very few of the plants of the carboniferous age will be found, because the large collection of these has not yet been classified and labeled, although it is temporarily arranged in cabinets and forms a most interesting section of the Museum.

The glossary of words and phrases accompanying this volume, and the compendium of the geology and mineralogy of the State reprinted from the fifteenth report are meant for the use of unlearned people who, without them, would be unable to understand properly certain parts of this report. It must be kept constantly in mind that a work of this kind is for the people first, for the learned experts next. If every person in Indiana were a master of science there would be little need for a geological report. You will find a few so-called scientists who would belittle the efforts to popularize scientific literature, but such men are fossils of the most ancient sort, without value to themselves or to mankind. Popular enlightenment is the only valuable enlightenment in a republic like ours. Educate the people and you educate the State, you fertilize the law, you make legislation upon difficult questions easy for the law-making citizen. I do not entertain respect for the kind of science which requires to be locked away from the masses of the people, nor do I think it adds anything to the dignity of knowledge when it sets itself apart wrapped in a cloak of unnecessary jargon. In this report, wherever it has been

possible, the use of obscure phrases or technical terms has been avoided, and where this could not be done every effort has been used to make clear to the popular understanding the substance of what was under consideration.

The lack of a chemical laboratory has been felt seriously, especially in connection with a discussion of the problem of natural gas. Indeed, the department has been hampered and hindered on every side in this connection. Professor Gorby's excellent report would have been very much assisted if it could have included a table of careful analyses of the gas, so that intelligent comparison could have been made; the want of these analyses, however, is not by any means the fault of any branch of the department, but is the necessary result of a meager appropriation and a wholly inadequate equipment of the office for the work expected of it. The State should see to this at once, as there is a constantly growing demand among the people for information which chemical analysis and assays are the only means of supplying.

Notwithstanding the circumstances under which it has been prepared, this report is submitted with full confidence that it contains a great deal of matter valuable and instructive which will be most welcome to the public.