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REPORT

—OF THE—

STATE GEOLOGICAL

—AND—

ECONOMIC SURVEY COMMISSION

—TO THE—

WEST VIRGINIA LEGISLATURE.

CHARLESTON,  
1898.





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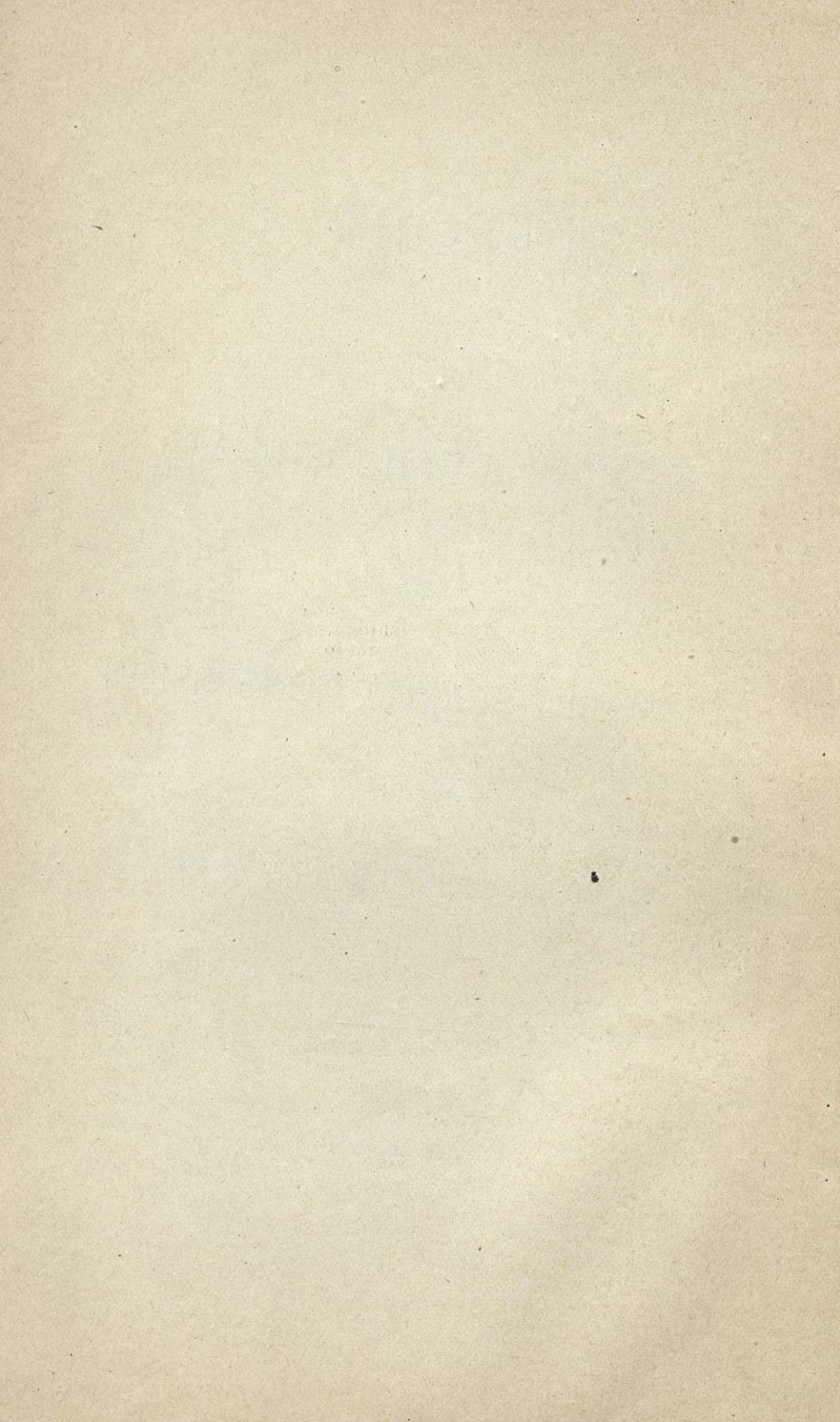
## ECONOMIC SURVEY COMMISSION

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# REPORT

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The Commission designated under the Act of the Legislature passed February 26th, 1897, establishing a State Geological and Economic Survey, has the honor to submit herewith its report required by the same. The Act in question reads as follows:

An Act to establish a State Geological and Economic Survey and to make provision for the preparation and publication of reports and maps to illustrate the natural resources of the State, together with the necessary investigations preparatory thereto.—[Passed February 26, 1897. In effect from passage. Approved February 26, 1897.]

Be it enacted by the Legislature of West Virginia:

1. That there is hereby established a State Geological and Economic Survey which shall be under the direction of a commission composed of the governor, the treasurer, the president of the West Virginia University, the president of the State Board of Agriculture, and the director of the West Virginia agricultural experiment station, who shall serve without compensation, but shall be reimbursed for actual expenses incurred in the performance of their official duties; and the said commissioners shall have general charge of the survey, and shall appoint as superintendent of the same a geologist of established reputation, and such assistants and employes as they may deem necessary; and they shall also determine the compensation of all persons employed by the survey, and may remove them at pleasure.

2. That the survey shall have for its objects:

First. An examination of the geological formations of the State with especial reference to their economic products, namely: Building stones and other constructive materials and resources:



clays, ores, and other mineral substances and fuels, the prevention of their waste, and the utilization of by-products.

Second. An examination and classification of the soils and a study of their adaptability to particular crops.

Third. An examination of the forests and timber lands of the State with reference to the economic utilization of the same and the prevention of their waste.

Fourth. An examination of the physical features of the State with reference to their practical bearing upon the occupations of the people, the industrial development and the material prosperity of the several sections of the State, having due regard to their varying resources, conditions and needs.

Fifth. The preparation of special geological and economic maps to illustrate the resources of the State.

Sixth. The preparation of special reports, with necessary illustrations and maps, which shall embrace both a general and detailed description of the geology and natural resources of the State.

Seventh. The consideration of such other scientific and economic questions as in the judgment of the commissioners shall be deemed of value to the people of the State, and the immediate establishing and the proper marking of the true meridian points in the several county seats of the State.

3. That the commissioners shall cause to be prepared a report to the Legislature before each meeting of the same, showing the progress and condition of the survey, together with such other information as they may deem necessary and useful or as the Legislature may require.

4. That the regular and special reports of the survey, with proper illustrations and maps, shall be printed as the commissioners may direct, and that the reports shall be distributed or sold by the said commissioners as the interests of the State, the diffusion of practical information relating to the development of the State, and the advancement of science may demand; and all moneys obtained by the sale of the reports shall be paid into the State treasury.

5. That all materials collected, after having served the purpose of the survey, shall be distributed by the commissioners to the educational institutions in such manner as to be of the greatest advantage to the educational interests of the State; or if deemed advisable the whole or part of such material shall be put on permanent exhibition.

6. That the sum of three thousand dollars annually, for the years one thousand eight hundred and ninety-seven and one thousand eight hundred and ninety-eight, or so much thereof as may be necessary, is hereby appropriated out of any funds of the treasury, not otherwise appropriated, for the purpose of carrying out the provisions of this act.



The first meeting of the Commission was held in the City of Wheeling, September 23rd, 1897, at which all the members were present, viz: Hon. George W. Atkinson, Governor of West Virginia, Hon. M. A. Kendall, State Treasurer of West Virginia, Dr. Jerome H. Raymond, President of the West Virginia University, Prof. T. C. Atkeson, President of the State Board of Agriculture, and Hon. James H. Stewart, Director of the West Virginia Agricultural Experiment Station. The organization of the Board resulted in the election of George W. Atkinson, President; T. C. Atkeson, Secretary, and M. A. Kendall, Treasurer. Satisfactory by-laws and regulations were adopted for the transaction of the business of the Survey, and Dr. Raymond was chosen Executive Officer of the Board and empowered to approve all bills before presentation for payment.

The office of the Survey was established at Morgantown, upon the offer of the West Virginia University and the West Virginia Agricultural Experiment Station to furnish suitable rooms free of all cost.

Dr. I. C. White of Morgantown was appointed Superintendent of the Survey, with the title of State Geologist, and his salary fixed at \$2,000 a year.

Prof. S. B. Brown of the State University was appointed assistant geologist, and curator of collections at an annual salary of \$250, and requested to prepare a bibliographical, and historical sketch of all previous work on the geological and economic resources of the State.

Action was also taken with reference to the Meridian work required by the act establishing the Survey, and the question of employing some one to do the work was referred to Dr. Raymond.

The Treasurer's bond was fixed at \$10,000, and after authorizing that officer to make a draft upon the Auditor for \$3,000 the Commission adjourned to meet at the call of its president.

The next meeting of the Commission was held at Morgantown, December 1st, 1897, at the request of the State Geologist, who had returned from Russia in November and formally accepted the office of Superintendent of the Survey. The former president of the State board of agriculture, Prof. T. C. Atkeson, having resigned that office, and Hon. S. W. Atkinson of Brooke county having been appointed to the vacancy, the latter gentleman was present as a member of the Commission, ex-officio, together with Governor George W. Atkinson, Hon. M. A. Kendall, and Dr. Jerome H. Raymond.

After the correction and approval of the minutes of the Wheeling meeting, Dr. White, the State Geologist, appeared before the Commission and made a statement of his plans for work during the ensuing year, in substance as follows:

- (1). The authorization of a contract with the U. S. Geological



## REPORT OF THE GEOLOGICAL AND

Survey for the location and marking of the true meridians in every county of the State, at a total cost not to exceed five hundred (\$500) dollars, the same to supercede the arrangement made by the Executive Officer with Prof. John L. Johnston in pursuance of action taken at the Wheeling meeting.

(2). The preparation and publication of a new map of the State to serve as a preliminary basis for geologic and economic purposes.

(3). The preparation by the State Geologist of reports upon Petroleum, Natural Gas and Coal, and their publication within the limits of appropriations made.

(3). The employment of a suitable person to act as Chief Clerk of the Survey and do the principal part of the work which is now required of the Secretary of the Commission.

(4). The employment of a Chemist for the Survey at a nominal salary.

After thorough discussion the State Geologist was authorized to carry into effect the plans above outlined.

The Secretary of the Commission having resigned that office Dr. Jerome H. Raymond was appointed to fill the same and serve without salary at his own request.

Dr. White tendered the Commission the use of his office and fire proof vault free of charge as the temporary office of the Survey which was accepted. He also requested that his salary should not begin until January 1st, 1898, and this arrangement was approved.

The meeting then after the transaction of some routine business adjourned to meet at the call of the President.

The third meeting of the Commission was called for the City of Wheeling at the office of Atkinson and Flick, September 14th, 1898, and the following members were in attendance, Governor George W. Atkinson, Dr. J. H. Raymond and Hon. S. W. Atkinson. The State Geologist was also present and submitted a verbal report of the progress of the Survey, and also made a financial statement showing that the funds (\$3,000) drawn from the State treasury on the warrant issued in September 1897 had all been expended for the purposes of the Survey, except a balance of \$20.46. The Commission thereupon authorized its treasurer to draw a warrant upon the Auditor for the unexpended balance of the appropriation (\$3,000) carried by the Act, and after the transaction of other routine business, adjourned to meet at the call of its president.

The fourth and last meeting of the Commission, at which this report was formulated, met on the call of the president at Charleston, Dec. 21st, 1898, the following members being present: Governor George W. Atkinson, Dr. Jerome H. Raymond, Hon. James H. Stewart, and Hon. S. W. Atkinson.



The State Geologist, Dr. White was also present, and submitted a detailed report of expenditures with accompanying vouchers properly approved by the Executive Officer of the Commission. The accounts were duly examined, found to be correct, and to agree exactly with the financial statement filed at the same time by the Treasurer of the Commission, Hon. M. A. Kendall, who was absent through sickness.

The State Geologist then submitted his annual report to the Commission which is as follows:

To Hon. George W. Atkinson, President of the State Geological and Economic Survey Commission:

The following summary of the work accomplished by the State Geological and Economic Survey during the past year is hereby submitted:

Under the authority conferred by the Commission when it appointed me Superintendent of the Survey, I proceeded to organize the same, after formal acceptance of the office on my return from Russia in November, 1897.

Owing to the limited resources granted by the Act establishing the Survey, it became a serious problem as to how the immediate work (establishing and properly marking the true meridians in every county) required by the Act, could be carried into effect and any funds be left for the main purposes of the Survey. In this dilemma, I turned to the United States Geological Survey, and happily secured aid and cooperation from that organization. Through the authority granted by the Commission at the December 1897, meeting, I concluded a contract with Mr. Charles D. Walcott, Director of the U. S. Geological Survey, under which the true meridians were to be established by that Survey in every county of the State, and all appropriately marked by stone monuments and metal tablets, at a total expenditure of only five hundred dollars (\$500), a mere tithe of the sum it would have cost had the work been done by the West Virginia Survey organization. This sum has already been paid to the National Survey upon properly certified vouchers for field expenses, and I am in receipt of information that the work of locating and marking the meridians has just been completed, the last monuments having been set at New Cumberland, Hancock county, on December 14, 1898. A full and detailed account of this work, the location of the different monuments, and the variation of the magnetic compass in the several counties of the State will appear in the Petroleum Report of the Survey which will be published in February or March of the coming year.

Prof. S. B. Brown of the State University who was appointed Assistant Geologist at the first meeting of the Commission, has about completed the task then assigned him, viz., a bibliography of all the published reports, maps and other writings concerning



the territory covered by West Virginia, not only during its existence as a separate commonwealth, but previously when it was a portion of Virginia. This interesting record will find a place in the Coal Report to be published as soon as the Legislature shall have granted the necessary funds.

Prof. R. L. Morris of the Engineering Department of the University, volunteered to prepare the base for a new map of the State at a very small compensation, and the result of his work is now in the hands of the engravers, A. Hoen & Co., of Baltimore, Md., with whom a contract has been signed for the publication of two thousand copies of the map, upon a scale of 10 miles to the inch, folded and enclosed in manilla envelopes with appropriate description thereon. The contract price for the two thousand copies delivered at the office of the Survey is three hundred dollars (\$300), and additional copies can be ordered at any time at the rate of fifty dollars (\$50) per thousand. This map will show the county lines, cities, towns, postoffices, railroads, and principal streams of the State. The location of the oil and gas pools will also be indicated by appropriate symbols, and the coal deposits (New River, Pocahontas, Kanawha, and Monongahela series) will be shown with separate colors for each series. The topographic base of the map is, of course, quite inaccurate, and must remain so until actual surveys by the government or State, or both combined, have covered our entire area, but as the State had no map of its own whatever, it was thought desirable to publish one, since even a poor map is better than none. This map is promised for distribution before the end of next month (January).

The Survey was fortunate in being able to secure the services of Mr. John M. Gregg, of Morgantown, W. Va., to act as Chief Clerk. Mr. Gregg has had much experience in general clerical work, is a skillful pen-man, typewriter and book-keeper, and has now added stenography to his other accomplishments. It is hoped that we may be able to retain his services permanently, but in order to do so his salary will have to be increased to a considerable extent above the meagre amount (\$50 per month) which our limited resources would permit for this year.

Prof. B. H. Hite, the accomplished Chemist of the State Agricultural Experiment Station, at Morgantown, has been appointed Chief Chemist of the Survey, at a merely nominal salary (\$10 per month) for the present, and he has made many analyses of coal, clay and other minerals during the year.

The State Geologist has spent as much time in the coal and petroleum fields as our resources would permit, gathering data for reports on the same. The report on petroleum and natural gas is nearly ready for the printer, and a contract for its publication will be let within a few days. We have no funds for any kind of illustrations, and from the bids received I estimate that



2,000 copies of the volume containing about 300 pages will cost approximately \$500.00.

The committee on publication, (Dr. Raymond, the Executive Officer of the Survey, and the State Geologist), has adopted the octavo form as the handiest, most popular and useful size for the principal publications of the Survey.

Several of the States of the Union, including our sister state of Maryland, have inaugurated a system of cooperation in their State Surveys with that of the National organization, the United States Geological Survey. The main purpose of such cooperation is to secure accurate topographic maps of the entire area of a state at small expense to the latter, and many years before such maps will be completed without such assistance and cooperation. That such accurate maps are absolutely essential to the rapid and orderly development of the vast natural resources of our State must be admitted by every intelligent citizen. The several letters addressed to me by the Director of the U. S. Geological Survey, Mr. Charles D. Walcott, will give the details of such proposed cooperation which is the same in terms as that given Maryland, New York, Connecticut, Massachusetts and other states where such cooperative surveys have proven so popular and beneficial are herewith filed for your information marked exhibit "A".

The benefits accruing to any state from the possession of these topographic maps have been recently so well set forth by Prof. A. A. Wright of Oberlin, Ohio, in an address before the Ohio Academy of Sciences at Columbus, that a copy of the same is included herewith and made a part of my report. Where the word "Ohio" occurs therein we have only to substitute in our own minds the words "West Virginia," and every syllable of Prof. Wright's masterly address will apply with equal and even greater force to our own State. The address in question reads as follows:

Members of the Ohio Academy of Sciences:

I have chosen a subject for this occasion which appeals very warmly to my own feelings, and concerning which I have some strong convictions. It enlists my interest as a citizen of this commonwealth, and it seems to me appropriate that it should be brought before this body, which is organized to represent the work and the sentiments of the scientific men of the state.

The proposition which I wish to urge is, that there is need of a topographic survey of Ohio, and that the time has come for having one.

#### DEFINITION.

By a topographic survey is meant a survey which takes account of the elevations and depressions of the surface of the land, as well as its horizontal extent; and which leads to the construc-



tion of an accurate map, with contour lines, at convenient intervals, joining points of equal altitude. While ordinary maps only attempt to locate objects according to their latitude and longitude, a topographic map adds to these their elevations above the sea level. While ordinary maps deal only with two dimensions of space, the topographic map deals with all three dimensions, and in this aspect is complete. We may call ordinary maps "areal" maps, as they show areas only. Such a survey as is proposed would yield a new and independent areal map of far greater accuracy than any which has yet been produced, for only upon such an accurate map would it be worth while to lay down the levels that are run by careful spirit level surveying.

#### NO ACCURATE MAP EXISTS.

There has never been any such survey in Ohio. The only organization in the state which has ever borne the name of a survey was the Geological Survey, which devoted all its labors directly to geology. While a topographic survey should logically precede a geological survey, and must precede the final and most accurate delineation of the geological structure of the state, yet its cost was uncertain, and its urgency seemed less to the legislators than that of the geological problems. The Geological Board did not take the view of the act under which it was organized, that it authorized them to make a topographical map before proceeding to their geological work. The only course that seemed open was the straightforward one of using the best areal maps that were available, as a basis for their work—the same common maps that we are using today. I have no criticism to offer upon the course of the Geological Survey; but it is to the point to inquire what our ordinary maps are based upon. I have made inquiry of map publishers both within the state and without the state, as to the existing sources for an accurate map of Ohio. The universal response is that there is nothing satisfactory. The country has been laid out into townships and counties, and there have been disconnected land surveys; but there is nothing in existence to prevent the accumulation of errors or to avert a control by which they may be diminished. It has sometimes transpired, in re-surveying regions as well settled and cultivated as Ohio or New York, that a town, and its environment, is found to have been placed two or three miles from its real position in latitude and longitude. The map makers say that they put together these limited and uncoordinated surveys and then use their best judgment in reconciling the discrepancies. So it is the "best judgment" of a man in an office in Chicago that gives our maps their finishing touches, instead of an actual measurement of things as they exist. It is true that there is a chain of most accurate triangles along the shore of Lake Erie, made by the Lake Survey,



and marked by permanent monuments. But these have been used, so far, only in making an accurate map of the shore line. Also in the northern part of our coal area and along the Ohio river, some points have been fixed and some elevations marked by the United States Coast and Geodetic Survey. We have thus the beginning of a primary triangulation of the state. What is needed is that these should be extended and applied until we have a map which can be used with confidence, and which will respond to the severest tests that can be put upon it.

#### VALUE OF CONTOUR LINES.

If now, upon such an areal map, the elevations and contour lines could be superposed, there would be added to its value an entire realm of facts which are at present unknown and unrealized by the ordinary citizen. If the scale of the maps were such as to permit the country roads and streams to be designated, as it ought to be, then they would lend themselves to a thousand uses of our every day life. At a glance one could locate the steeper slopes and the level stretches. The traveler, whether on foot or on wheel, can know the ups and downs of his journey beforehand. The land buyer can bring to book the descriptions of the land seller, seeing for himself what is upland and what is river-bottom, delineated by an authority that is entirely impartial. The engineer can lay out the preliminary profile of his turnpike or electric railway at his office desk, being sure the correctness of the large points of control; city engineers can calculate the water supply that is tributary to their towns, can know at what levels it can be impounded, and learn by inspection the most economical location of dams, reservoirs, and pumping stations. The feasibility of projected ship-canals and the comparative merits of different routes can be in great measure settled, without expense. The manufacturer, the miller, the miner, the contractor, can know beforehand the best location for his factory, his mill, his shops and his headquarters. Eventually the geological outcrops can be transferred to the same map in a scheme of colors, the geology explaining the topography and the topography suggesting the geology. Then the sheets will be bearing something like the load of correct information concerning the surface of the state that should be demanded and furnished by an intelligent commonwealth.

#### SCIENTIFIC USES OF THE MAPS.

But these considerations are largely pecuniary. There are others that are scientific, intellectual, and educational, and which will be more highly valued by the thinking citizens of the State. The naturalist has a sore need of topographic maps in all his en-



deavors to explain the geographical distributions of plants and animals. In his field excursions, as a mere guide for his trips, they make all the difference between high satisfaction and regret that he has not a better map; while in explaining and recording the distribution of plants and animals, the topography is a factor which injects itself into his problems at every turn. The geologist who is endeavoring to unwind the history of the preglacial drainage of the State and its relations to modern drainage, has at present to map his own topography; and he has nothing to suggest localities where evidence on critical points might be obtained. Unless he is fortunate enough to see the topography of a locality with his own eyes, he cannot know whether there is any problem deserving study at that point or not. In contrast with this we see Professor Davis of Cambridge taking the elaborate maps of France and Germany, and, in his laboratory, writing with confidence of the episodes in the history of the Meuse and Mosel rivers, leaving scarcely a word or an opinion to be altered when the place is subsequently visited in person. The physicist and the meteorologist are in equal need of a knowledge of altitudes that they may interpret aright the pressure of the atmosphere and its varying phenomena. Indeed, one cannot foresee all the benefits that would arise from the survey proposed, for every step forward in exact science is sure to open up, and form a basis for, unexpected advances in related lines. Our duty is to push forward in faith, being sure that our horizon will be broader from the new position attained.

### TRIUMPH OVER NATURE.

As a matter of mere intellectual triumph over nature, the utility of this survey may be urged. Ohio has been settled for over a hundred years, and has become one of the most important commonwealths in the Union. Its interests are diversified. It has enjoyed general prosperity, and in education, in the support of public institutions, and in intelligent appreciation of the best things, it has an honorable standing. But is it not high time that an intelligent people should construct for themselves, and thus be able to contribute to the world a consistent and complete representation, in three dimensions, of that portion of the earth's surface with which their fortunes are inevitably linked? To subdue, to cultivate, to comprehend, to prepare for man's uses with the utmost refinement this surface which is the most persistent and conspicuous element in the environment of man, should be a task, in the accomplishment of which a worthy sense of satisfaction and triumph may well be indulged.

### SHALL OHIO BE BEHIND?

Moreover, if we are to keep our place in the ranks of the more



enlightened states and countries, we cannot delay long. Several of our Eastern States, including Massachusetts, Connecticut, Rhode Island, and New Jersey, have their topographic maps entirely completed, and are reaping the practical and intellectual benefits of their enterprise. Several others, like New York, Missouri, and California, have their maps partly completed, while considerable areas of Western territory have been mapped by the surveying forces of the National Government. A number of our neighboring states to the westward are maturing their plans for such a survey, and ere long Ohio, if she does not move, will seem to be a laggard upon this subject. The European nations have long ago provided themselves with surveys of great elaborateness of detail, by government authority. We shall not be leading, but rather following, in our appreciation of the advantages of a correct and complete map—if we enter upon this task at once.

#### EDUCATIONAL ASPECT.

In one other aspect, the utility of such a map may be urged, and urged with greater force than it could be at any previous epoch. This is the educational aspect. Within a few years past a new vitality has been infused into the subject of geography in all its branches, from the simple forms first given to children, up through physical geography and phytography to dynamic geology, and the origin of surface forms. The "New Geography" differs from the old in looking at surface features—not as dead and fixed forms, but as passing through the stages of growth, maturity, and old age. Every mountain, plain, and river valley carries in its structure the record of its birth, decline, and perhaps rejuvenation; always changing, never resting, always pursuing the steps of its evolution, slow though they be. This newer conception of the science, together with the better methods of teaching, which send both teacher and pupil directly to nature, create a necessity for a kind of maps and of literature which do not as yet exist. As the study begins with home geography, every school district must work out a geography for itself which will be different from that of any other district. In order to do this, there is need of certain standards and starting points which a survey of the State would furnish, and there is need of a varied supply of topographic forms, already mapped and accessible for study, both to teacher and pupils. These must be supplied by the sheets covering other portions of the State or of other states and countries.

The ability to read and interpret a topographic map is almost as foreign in the people of average education today, as in the ability to understand a common map among those who are wholly uneducated. Considerable practice is necessary before one



can appreciate comparative altitudes, or image in one's mind the profile of a slope, from the contour lines of a map. It is like the study of solid geometry and it requires the command of the imagination in a constructive process of some complexity, but still not difficult. The ability to read such a map is of great advantage to any mind. To represent topography in solid models or raised maps is an expensive and tedious task. The cheapest and most available way of presenting topography is upon maps with contour lines; and it is not too much to say that every school-boy should have practice in the use of such maps.

#### PLANS FOR A SURVEY.

But however desirable a topographic survey may seem to us, we shall not be discussing the subject to any purpose until some practical plan is proposed of making the survey, and its cost considered.

Three different methods of procedure may be mentioned, in which the cost would vary with the method pursued. The first method suggested would be that of utilizing the various railroad profiles that cross the State in every direction, as a basis for altitudes, and working from these with the aneroid barometer for the intermediate country. The contour lines for altitude could thus be obtained. For the areal map, upon which these lines should be laid down, we might use the best existing maps of the State and of the separate counties, or the best that could be made by new compilations, without resorting to a triangulation survey. This would undoubtedly be the least expensive system that could be devised. It is the method resorted to by the State of Illinois shortly prior to the Columbian Exposition, to obtain the data for a raised map or plaster model of the State for exhibition in 1893. It was estimated by Professor Rolfe, who superintended the work, that the errors in the elevations would rarely if ever exceed ten feet.

A second method would be for the State to co-operate with the topographic division of the United States Geological Survey, of Washington, the work being done by their experienced engineers. Upon this plan there would be a primary triangulation survey, covering the entire State with large triangles. The smaller areas would be worked out with the plane table and other processes, the result being an entirely new and independent areal map of the State as it is. The hydrographic division would give especial attention to the correct representation of the streams and drainage of the State, while a third division would give the elevations, these being taken entirely by surveyor's level, and nothing being left to the shifting barometer. The maps resulting from this survey would be in harmony with a plan already well inaugurated by the United States survey, of eventually covering



the whole country with a good topographic survey preparatory to a complete geological survey. Over 600 topographic sheets have already been issued, each sheet covering a quarter of a degree square, or some multiple of this area. The United States survey will place its topographers in those states where cooperation is offered, they themselves bearing half the expense of the survey, while the state contributes the other half.

This kind of a survey would be vastly more accurate and valuable than the railroad and barometer survey, and would cost a good deal more. But it would cost the State only half the actual expense of the work.

A third method would be to organize a State topographical survey, for the purpose of making a map, of such a degree of elaborateness as might be agreed upon. It ought to be nothing less than a trigonometric and spirit level survey, resulting in an entirely new and authoritative areal map as well as altitude map. It might be made upon a larger scale and with more detail than the one which the geological survey would propose, but their proposal would be such a great advance upon anything now in existence that the State would not be likely to support anything more elaborate. The comparative merits of the second and third methods may be judged by proposing that they should both undertake to produce the same map. Which of the two could produce the map at the least expense? There is at present no bureau under the State government which is equipped for such an undertaking. It would be necessary therefore to organize one anew if the State should undertake the work. New instruments, offices and equipments of every kind would have to be provided, a corps of engineers appointed, organized and trained, and all the preliminary questions as to methods of procedure discussed and settled, before the beginning of efficient work. The United States engineers, on the other hand, are already in efficient working order. Considering these facts, it has been estimated by careful experts that it would cost the State of Ohio three times as much to produce a map as it would the United States Geological Survey. And since the National Survey would be willing to bear half the actual expense, it would cost the State only one-sixth as much, to co-operate, as to proceed independently.

Of the three methods, therefore, there can be no question that the adoption of the second would give the best results for the money expended; and it would seem that all consideration of the subject of a topographic map ought to be concentrated upon this one plan.

#### RESULTS IN OTHER STATES.

The results of State co-operation with the United States Survey have been very satisfactory in the States where it has been



tried. New Jersey was the first State to complete her work in this manner, and it has already become classic ground in the advanced study of topographic forms and their development. Every school district in the State has been supplied with a full set of the maps, both topographic and geologic. In Massachusetts, Professor Shaler says the educational argument was the consideration that really carried the day, though other arguments were numerous. The points gained, he says by co-operation were that "we got a better map and got it sooner than we could possibly have obtained it in any other way."

In Connecticut, Professor Brewer, of Yale, says: "The map has been very satisfactory; is used for a great variety of interest. The Geological Survey did its work well, very well as a whole, although the sheets are of unequal excellence." The expenditure was somewhat less per square mile in Connecticut than in Massachusetts.

Dr. Walcott, the Director of the United States Survey, has kindly written out in some detail, suggestions and estimates for a survey of Ohio, and the course that matters would be likely to taken can best be learned by noting his statements. He says:

#### DR. WALCOTT'S STATEMENT.

"In view of the highly cultivated condition of the State and the density of its population, I am of the opinion that, if a fixed scale be deemed best for the whole State, that scale be the same as is or was employed in mapping New York, Pennsylvania, and the New England States, viz: approximating one mile to the inch, with a contour interval of twenty feet. Such a scale will be decidedly the most satisfactory from a topographic point of view, and the resulting map will be much more satisfactory for engineering purposes and as a general base and guide map for all purposes. It is sufficiently large to admit of the representation of all the numerous cultural features which will have to be shown. If, on the other hand, it is desired to economize, a scale of two miles to the inch may be employed, but the relief is so slight that the contour intervals should be twenty feet. To make such a map will cost but little less than to make the former, because the chief cost will be incident to obtaining the vertical relief contours; yet a saving of about \$2 per square mile may be made by employing this scale. In this event it would still be necessary, in my opinion, to map the atlas sheets containing the larger cities, those say containing over 50,000 inhabitants, on the larger scale, employing the smaller and cheaper scale for the remainder of the area.

"The State of Ohio contains 40,760 square miles, most of which is well inhabited and fairly clear of timber, and well cut up with roads, so that its survey will not be especially difficult. Practically none of this area has yet been mapped, nor is there in exist-



ence any map material other than elevations along railway and canal lines which will aid in the preparation of the topographic maps.

"The survey of 40,000 square miles on a scale of one mile to the inch, with twenty foot contours, and including the running of the necessary primary level lines, will cost between \$8 and \$9 per square mile for the whole State, provided money be forthcoming in sufficiently large amounts to enable the work to be conducted in the most economic manner, say at a total rate of expenditure of \$20,000 per annum, or a total maximum cost for topography of \$360,000. In addition the prosecution of the primary triangulation over this area will cost at least \$1 per mile, perhaps a little more. Say for this \$40,000, provided funds for this work be forthcoming at the rate of not less than \$5,000 per annum. Accordingly the total cost of mapping the State, including triangulation, will average \$10 per square mile and amount to \$400,000.

"The State of Massachusetts was mapped at an average cost of \$12 per square mile; Connecticut at about \$10.50 per square mile. This organization has agreed to map New York State for \$10 per square mile. The work has progressed at that rate for the past four or five years, but owing to the introduction of more careful spirit level work it will cost henceforth a little more. The State of Ohio could probably be mapped for \$7 per square mile, but owing to the total lack of primary triangulation, which was almost complete throughout the areas of New York and New England, and owing to the necessity of doing better spirit level work than was formerly done, I am of the opinion that the figures above given will be very close to the truth.

"Estimating the total cost of the survey to be \$400,000 the State would have to appropriate \$200,000. If this sum were appropriated most advantageously, it would be at the rate of \$25,000 per annum, or \$50,000 per legislative session. This organization would appropriate a like amount, the total annual expenditure being \$50,000. At a rate of survey corresponding with this, eight years would be required for the completion of the mapping of the State. Lesser biennial appropriations would prolong the time of survey proportionately and increase the cost a little.

"The map would cost the State \$5 per square mile, and for this relatively small outlay the State will receive an accurate topographic map of its entire area on a scale and at a contour interval sufficiently large to represent all its cultural and topographic features. This map will show the surface relief for every twenty feet of vertical height. It will show the direction and position of all streams, ponds, lakes and swamps. It will show all roads, public and private, and all houses in their true position and in such manner as to indicate their relation, not only to each other, but to the drainage system and to the hills, valleys and slopes of the State. It will also show the outline and extent of all wood-



ed areas. As permanent monuments of this survey, there will also be left all over the country so mapped, copper bolts or plugs, marking exactly the geodetic position of primary triangulation points. These will be at distances apart not greater than twenty miles, and will serve as initial points for the conduct of all future surveys of every kind. There will be left copper bolts or tablets at points six miles apart throughout the entire State, marking the elevation of these points above sea level to the smallest fraction of a foot. These will serve as datum points for the prosecution of further spirit level work for all engineering investigations and for such public works as canals and municipal water supply, or for railways or other private or semi-private surveys.

“As acknowledged by the State engineer of New York, and by other authorities who have co-operated with this survey, their States could not, and I am confident that Ohio could not, duplicate such a survey for two or three times the cost at which it can be prosecuted by the well organized and well disciplined force of the Geological Survey. It would probably cost the State to map its territory alone \$30 per square mile, against \$5 by the other plan. Moreover, the State will have these maps engraved by the Government (a most important item) free of cost, as they will be engraved by the Geological Survey. Furthermore, when these maps are completed they will be put to the primary use designed by the Government, namely, as base maps upon which to represent surface and economic geology. The State will thus come into possession of a set of geologic maps at no further cost to it than one-half the cost of the topographic survey. Still another benefit which will accrue to the State by having this survey made in co-operation with the Geological Survey is that a great mass of information will be gathered in the course of the map-making relative to the drainage and water supply of various streams, both through the topographic and hydrographic branches of this survey; and this information will be of inestimable value to all who are engaged in the utilization of the water resources of the State, either for domestic consumption, the supply of canals, or the production of power for water supplies. The State of Maine considers this feature of the topographic survey alone as warranting the expenditure; as does also the State of New York, in connection with water supplies for its canals, and in making compensation to mill owners for water diverted from them for State uses.

“I would suggest that bills be introduced biennially in the legislature, similar to those passed by the State of New York, and carrying sufficient appropriation to continue the work from one session of the State legislature to the next. This should be expended either through a commission, as in Massachusetts and Connecticut, called a State Topographic Survey Commission, or better still, be expended through one individual or office, as in the



case of New York, which is represented by the State engineer and surveyor. The State representative is generally empowered to examine the reports, accounts, and field work in connection with the Geological Survey, and if at any time he finds the work is not being done in accordance with the agreement, he may terminate it."

#### CLASSES BENEFITED.

In addition to these details concerning a plan of survey, the Director has answered some questions as to what classes of persons have been benefited by the maps and have sought them for use. He says:

"From Massachusetts we have received numerous appeals from educational institutions requesting maps for school purposes. Engineers and projectors of public enterprises and those interested in hydrography and sanitation apply for the maps to study topography, water supply and drainage. Those having large realty interests also endeavor to obtain the maps to locate thereon their landed estates. Of recent years a constant and growing demand has been made by bicyclers. The requests originating from Rhode Island are of a general nature, but have not left an impression of any special or distinctive characteristic.

"From Connecticut we receive letters similar to those received from Massachusetts, with the addition of that influence caused by the suburban interest of New York City.

"In New Jersey the requests are varied, railroads and farming sharing equal portions of the interest of the applicants. These States are, however, all included in a thickly settled region of advanced development. But from other States where the best existing ordinary maps are few, being compilations from various sources and records, there originates another class of applications. The home seeker, mining prospector, railroad and irrigation engineers, investment companies and all of the many followings of commercial life are numbered among those who appeal to the Government for maps."

The sheets composing the map of Ohio would doubtless be issued in uniformity with the sheets covering New England, each being about 17 by 21 inches in size, and printed in three colors, the streams and bodies of water in blue, the contour lines of elevation in brown, and the works of man, or "cultural" portion, such as roads, houses, towns and political divisions, in black. Each sheet would have a name from its principal town, as the "Columbus" sheet, the "Lorain" sheet, etc. The sheets could be kept separate in a portfolio, for use singly, or they could be bound into a thin atlas.

These details of information, furnished by the Director, places the project before us in a very definite form. The nature, the



quality and the expense of the work can be certainly known beforehand.

#### ACTION AT THE PRESENT TIME.

The question of inaugurating topographical work in Ohio has been exploited before, without success. Twenty-five and thirty years ago it was a frequent subject of appeal by Col. Cyrus Whitteley, of Cleveland, in connection with the development of the coal seams of the north-western portion of the State. Later, in connection with the State geological survey, the needs of such a survey were urged, but its claim seemed not to be appreciated by the legislature. During these years of waiting, however, the National survey has been developing remarkable strength and acquiring most valuable experience, both by its tentative and by its completed work. And now the opportunity is afforded us, through their co-operation, of obtaining a topographic map, executed upon such a scale and plan, reaching such a degree of quality, and upon such a scale of expenditure as has commended itself to the judgment and experience of the most important States lying to the east of us. Is there any wiser, more economical, more business-like way of obtaining such a survey? The entire cost of \$200,000 is no more than has been repeatedly and properly expended in the erection of a single building for some of our public State institutions. It is less than one-third of the amount which was recently given by Mr. Rockefeller for extending and beautifying the park system of Cleveland, a city in which he had formerly resided.

The benefits of a topographic survey would be distributed to every part of the State, to every square mile of its area and to every citizen within its limits, ministering to his physical and intellectual advantage, and prompting him to enterprises of public importance. To undertake it is a duty which all owe to all, and the legislature in providing for it would merely be recognizing the obligation which the commonwealth owes to itself and to the world."

The question as to how the citizens of the State would share in this work if it is to be undertaken by the U. S. Geological Survey, is specifically answered by the following statements from Mr. Herbert M. Wilson, Topographer of the U. S. Geological Survey.

"According to the plan pursued by other States, only a limited number of men will be sent out from Washington, the larger number being employed in the region where the work is in progress. The work will be in charge of from ten to a dozen of the experienced topographers permanently employed by the United States, acting as chiefs of parties. All other surveyors, as level



men, transit men, etc., together with rod men, assistants and helpers, will be employed in accordance with the regulations of the Department of the Interior, in the locality in which the work is being done. Thus the local surveyors and engineers of the State of West Virginia will find employment, and the benefits will inure to them both in compensation for services rendered, and in the possession of the fixed monuments which are established by the surveying parties.

"The salaries of all the employes will be paid by the Federal Government, and certain portions of these sums will naturally be expended in the regions where the work is going on. The money which is appropriated by the State will go in payment of the subsistence of the parties, and in supplies. It will thus be going to hotel keepers, to dealers in provisions, to hardware men, to livery men and others for the hire of animals, and the like. Thus all the money appropriated by the State, and more than half of the similar sum appropriated by the Federal Government, will be expended within the State."

That accurate maps are absolutely essential to the proper delineation, and description of a State's mineral and other resources, admits of no controversy, and we now have the opportunity of receiving these at a very small annual cost, not exceeding \$10,000 per annum to the State through a period of only 10 to 12 years. It is the part of wisdom to avail ourselves of this proffer of Governmental aid at once, since most of the counties of the State have no official maps of any kind, and those extant are so inaccurate and out of date as to be little better than worthless.

The following estimate of annual appropriations necessary to carry out the requirements of the Act establishing the State Survey is based upon the expectation that co-operation with the National organization will be inaugurated by the coming session of the Legislature:

For co-operation with the U. S. Geological Survey in the preparation of a complete topographic map of the State .....	\$10,000
For salaries of the State Geologist and three assistants...	4,000
For salary of Chief Draughtsman and Topographer and two assistant topographers .....	2,500
For salary of Chief Chemist.....	300
For salary of Assistant Chemist.....	600
For salary of Biologist.....	300
For salary of Botanist .....	300
For salary of Entomologist.....	300
For salary of Chief Clerk.....	1,200
For salary of Assistant Clerk.....	500
For Engraving, Printing and Binding.....	5,000



For field, office, traveling and incidental expenses.....	5,000
Total .....	<u>\$30,000</u>

The above estimate is based upon the most economical plan of securing a complete topographic map of the State, within a period of twelve years, by co-operation with the National Survey, and at the same time completing the study, classification, description and publication of all the natural resources, and other data contemplated by the Act under which the Survey was organized. The only item of this estimate which could be subject to any material variation, and not impair the efficiency of the survey, is the first one. That item can be either increased or diminished, and its only effect will be to change the time for completion of the topographic map. The estimate of Director Walcott of the United States Geological Survey, based upon actual cost in several States, is \$5.00 per square mile, as the price each State must pay on the present plan of co-operation for a completed map on the scale of one mile to the inch. Since there are 24,000 square miles in our area, the entire cost to the State of West Virginia will be \$120,000, and this can be distributed through 20 years, 12 years (as I have suggested), and 10 years, or even 5 years, by simply making the appropriation for each year's compensation either smaller or larger. For every dollar the State puts into the field work on the map, the Government will not only put another dollar, but pay all the salaries of the surveying corps, and in addition bear the entire expense of engraving the maps in the highest style of art, upon plates which are to be preserved forever. Should it be desired to have this work completed in six years instead of twelve, then the appropriation for co-operation must be \$20,000 annually instead of \$10,000 as above recommended.

Should this plan of co-operation submitted for your consideration be presented to the Legislature, and adopted by that body substantially as here recommended, the State Geologist would be enabled to carry into execution within the twelve (12) years contemplated, all the requirements of the original Act, and in addition to the reports on special subjects, would be enabled to publish a volume on each county of the State with a full description of its geology, and natural resources of every kind, together with a correct topographic map of the same. These detailed reports prepared by experts, and under the authority of the State, would be of great and lasting value to the several counties, as well as to the State at large, since the summary of the detailed county work would also be published covering the State as a whole, and correlating as well as classifying the results of all geological and other investigations.

The detailed financial statement which has been submitted may



be summarized and supplemented by estimated expenditures to April 1, 1899, as follows:

## EXPENDITURES.

For locating and setting Meridian monuments, U. S. Geological Survey, paid in full.....	\$ 499.96
Field and traveling expenses.....	254.81
Office expenses, including postage, stationery, telephone, expressage, etc. ....	184.35
Salaries to December 1st, 1898.....	2,953.50
Salaries to be paid to April 1st, 1899.....	990.04
Expenses of three meetings of State Commission.....	124.00
Expenses of Charleston meeting of the Commission....	74.78
Contract with A. Hoen & Co., Baltimore, Md., for publication of 2,000 copies of State map, to be paid.....	300.00
Cost of publication of 2,000 copies of Report on Petroleum, True Meridian locations, etc., estimated.....	500.00
Office and incidental expenses to April 1, 1899, estimated .....	75.00
Total .....	<u>\$5,956.44</u>
Appropriation for the Survey .....	\$6,000.00
Total expenses as above paid and estimated to April 1, 1899 .....	<u>5,956.44</u>
Estimated balance, April 1, 1899.....	\$43.56

Notwithstanding the law upon the statute books requiring the several gas and oil companies operating in the State to shut in all gas wells and prevent the waste of this precious fuel, there is yet an enormous waste going on in several counties of the State. There is a penalty attached for non-compliance with the law, but so far it has never been enforced, and is not likely to be until some one person is charged with the execution of the statute. The State of Indiana has found it necessary to have a special officer called the State Gas Inspector, whose duty it is to see that the law is enforced on the subject of the prevention of natural gas waste, and the proper penalty exacted for its violation. I think this is the best plan of preventing the evil complained of, and that the attention of the Legislature should be called to the matter.

In one county alone (Wetzel) it is estimated that the waste of gas, counting that which escapes with the oil production, and which the present statute does not therefore prohibit, amounts to much more than 100,000,000 cubic feet daily. When we remember that this is equivalent in heating power to more than



100,000 bushels of coal, the loss to the resources to the State becomes simply appalling, and calls loudly for some effective remedy.

All of which is respectfully submitted.

I. C. WHITE,  
State Geologist.

Morgantown, December 20th, 1898.

After a thorough discussion of the above report of the State Geologist, the Commission unanimously approved the plan proposed by him for the future work of the survey. The proposed co-operation of the United States Geological Survey is especially approved, as well as all the other features recommended by Dr. White for the completion of the State Geological Survey so essential to the future prosperity of all the people of the State. The Commission also went carefully over the several items in the estimates submitted by the State Geologist and it unanimously endorsed the same, and asks the Legislature to appropriate the full amount of thirty thousand dollars per annum for the years 1899 and 1900. The State Geologist was authorized to contract with the lowest responsible bidder for the immediate publication of his report upon petroleum and the meridian locations in the several counties.

The Commission then adjourned to meet at the call of the President.

(Signed.)

GEORGE W. ATKINSON,  
President.

JEROME H. RAYMOND,

Secretary.

Charleston, W. Va., December 21st, 1898.



