Shall Mississippi Have Development of These:

ARTMENT OF GEOLOGY

Oil and Minerals; Drainage; Highways; Water Powers; Health Surveys?

> THEN GIVE US A TOPOGRAPHIC SURVEY!

> > E. N. LOWE

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The STATE GEOLOGICAL DEPARTMENT was organized under the name "Geological, Economic, and Topographic Survey of the State of Mississippi." Under the heading, "Objects and Purposes of the Survey" the first two mentioned are these:

"(a) An examination of the economic natural resources of the state, viz.: The metalliferous deposits, petroleum, natural gas, as well as building stones, clays, coals, cements, waters, and all other substances of value."

"(b) The said Board shall have prepared and published a topographical survey and maps of Mississippi," etc.

Since its inception, with the small fund at its disposal, the Geological Survey has conducted its activities along numerous lines, meeting as best it could, the demands of the State. From the beginning the topographic mapping has impressed the management of the Survey as of prime importance, but the insistent demand for soil surveys early directed our energies and the major part of our funds to that purpose. Just at that time the cotton boll weevil forced the farmers of the state largely into diversified agriculture, and the rapid survey of our soils became imperative.

Nearly half the counties of the state have had detailed soil surveys, and the maps and reports have been very much in demand.

While the soil surveys were progressing, the Geological Survey has made a study of the general geology of the state, has investigated many mineral resources of great potential value, has surveyed the underground waters, and has touched upon many economic problems of the state that still invite solution. These investigations have been embodied in published reports and bulletins that have been distributed throughout the state and the country at large, and even into foreign countries. A lively demand exists for our publications from all parts of the country.

We have been impressed with the frequent and insistent demand for topographic maps of Mississippi; this has been especially notable during the past year, in which time there has been manifest a renewed and ever-increasing interest in oil and gas possibilities in the state.

Early in the present year (1919) the State Geological Survey prepared and issued a small bulletin showing the result of oil prospecting in Mississippi up to the date of publication. This report, to have given the information one would have expected on that subject, should have been accompanied by a topographic map of the state, or at least of the parts considered favorable for oil prospecting. Such a map we were unable to furnish, for the reason that practically no topographic mapping has been done in this state. THE STATE HAS NEVER APPROPRIATED SUFFI-CIENT FUNDS to justify us in even beginning such work.

For the past eight years the Geological Survey has received an annual fund of \$6,000. Of this sum, \$2,000 has been set aside for the Director's salary, and with the remainder office assistants and expenses, soil survey assistants, and all field expenses have been paid. To that rather narrow range of activities we have been constrained to limit ourselves by lack of more liberal support. Such other investigations as we have been able to make have been carried on largely incidental to the above restricted program.

A large, and in many respects, the most important program of operations lies now before us, and whether we can seize the opportunity for larger service, and meet the needs of the hour, will depend upon the adequate support given to this Department.

THE STATE NEEDS A TOPOGRAPHIC SURVEY. Since the inauguration of the State Geological Survey we have hoped that each new Legislature would give us that liberal support that would make it possible for us to carry out the second purpose of the Survey as stated in the law by which it was created, namely, to prepare and publish "A topographical survey and maps of Mississippi."

Our work in the past has been very largely general and of reconnoisance nature. We are now ready to begin a detailed survey of the state, and a topographic survey has become a necessity for further progress. Detailed geological survey work cannot be carried on satisfactorily except on topographic base maps. An accurate topographic survey is a condition precedent, to use a legal phrase, of all such activities.

What are these activities based upon a topographic of survey? We can do no better than quote the Director of the United States Geological Survey. He says: "Among other uses of the topographic maps are the following:

1. As preliminary maps for planning extensive irrigation and drainage projects, showing areas of catchment for water supply, sites for reservoirs, routes for canals, etc.

2. For laying out highways, electric roads, railroads, aqueducts, and sewerage systems, thus saving the cost of preliminary surveys.

3. In improving rivers and small waterways.

4. In determining and classifying water resources, both surface and underground.

5. In making plans for the disposal of city sewage, garbage, etc.

6. In determining routes, mileage, location of roadbuilding material, and topography in country traversed by public highways.

7. In selecting the best routes for automobiling tours and inter-city runs.

8. As guide maps for prospectors and others in traveling through little-known regions.

9. As bases for the compilation of maps showing the extent and character of forest and grazing lands.

10. In classifying lands and in platting the distribution and nature of soils.

11. In compiling maps in connection with the survey and sale of lands.

12. In making investigations for the improvement of the plant and animal industries, and in a comprehensive study of physical and biological conditions in connection with the stocking of interior waters with food fish and the locating of fish culture stations.

13. In locating and mapping the boundaries of the life and crop zones, and in mapping the geographic distribution of plants and animals. 14. In plotting the distribution and spread of injurious insects and germs.

15. As base maps for plotting of information relating to the geology and mineral resources of the country.

16. In maneuvers of the national guard, in the development of military problems, and in the selection of routes for road marches or strategical movements of troops, particularly of artillery or cavalry.

17. In connection with questions relating to state, county, and town boundaries.

18. As a means of promoting an exact knowledge of the country, and serving teachers and pupils in geographic studies.

19. As base maps for the graphic representation of all facts relating to population, industries, and products of other statistical information.

20. In connection with legislation involving the granting or charters, right, etc., when physical knowledge of the country may be desirable or necessary."

From the above it may be seen what a wide field of usefulness a topograhic survey serves. There will be no attempt here to elaborate on these points in detail, but a few will be mentioned that especially concern Mississippi at this time.

DRAINAGE-A few years ago it was estimated that about 6,000,000, acres of lands in Mississippi were classed as swamp and overflow lands. The successful maintenance of levees along the Mississippi has materially reduced this acreage within late years, but by far the greater part of it is still to be classed as swamp lands, low, flat, and badly in need of drainage. Of course the Delta furnishes the largest bodies of lands needing drainage, but every county in the state has low, wet lands bordering streams that need drainage. With proper drainage, lands that are now practically useless would within a very few years become among the most valuable in the state. These bottom land soils are so rich that production would be enormously increased and the higher taxable values of the lands would be sufficient to pay for a topographic survey within a few vears.

All drainage schemes are of necessity based upon a previous topographic survey, or must provide such a survey at the very beginning of such operations. The proper location of mains and laterals are dependent upon an accurate knowledge of surface contours, which knowledge can be obtained only from a topographic survey.

The drainage needs of the state are so widespread practically every county having its share of these problems —that the execution of an accurate topographic survey resolves itself into a state problem, and the state would be justified in issuing bonds for such work, for the benefits lie even more largely in the future than in the present.

That several million acres of the most fertile lands in the state should be practically lying waste is little less than appalling. We fail to appreciate fully what that means, because these lands have never yet been part of the productive wealth of the state. Reverse the picture, and imagine an equal acreage, or even half as much, of now productive and fertile land withdrawn from usefulness and allowed to lie idle; it would strike us at once as calamitous, almost criminal, if it could be prevented.

Drainage of our marsh and swamp lands is essential to our best prosperity, and a topographic survey, the first step looking to that end, is no less essential.

HIGHWAY CONSTRUCTION—The whole country has turned with enthusiasm to the construction of better highways. Mississippi has caught the contagion. Everywhere there is a vigorous voice raised for more and better roads. In view of what we have had, or rather what we have not had, in the way of permanent highways in the past, this general movement for better roads is timely, and may indeed be considered necessary, if our state is to keep pace with the general economic development of the country.

As nearly as possible every farmhouse should be upon, or accessible to, a good highway. In this day of automobiles, motor trucks, and improved farm machinery, better roads become a necessity in order that our rural population can receive the benefits of good schools, town enjoyments, social uplift, and ready access to markets with their produce.

But, BEFORE HIGHWAYS CAN BE BUILT, topographic surveys must be made, in order to determine the most feasible routes, to establish permissible grades, avoid obstacles, such as marshes, lakes, rough ground, etc. A general and accurate topographic survey not only presents alternative routes through a region, with a sound basis for calculation of cost of each, but may serve many other uses, as for drainage, terracing, soil survey, mineral survey, and others.

WATER POWER SITES—Mississippi cannot compete with the neighboring states of Alabama, Georgia, North Carolina, or Arkansas in large water power sites, but there are numerous smaller power sites in the state, none of which are being utilized, but when properly surveyed out will prove valuable. The State Geological Survey knows several of these of which will doubtless in the future be made use of. Many thousand horsepower go to waste every day, which could and should be made to serve our population in lighting our towns, giving motive power to street car and trolley lines, running manufactories, etc. Water power for generating electricity is the cheapest power available, and is being used more and more in many parts of the country.

A topographic survey will locate possible water power sites by determining the gradients of streams, reservoir sites, etc., and this, in conjunction with a hydrographic survey will give accurate data upon which the horsepower can be estimated.

At this writing (December 3, 1919) the daily press contains an account of a notable meeting in New York, which has just taken place. At this meeting steps were taken to form a national association to urge the development of all the water powers of the United States. This water power was estimated at 100,000,000 horsepower, with an annual value of \$5,000,000.00. "The government will be asked to take the initiative, and private capital will be en-

7

listed for development of power sites. The promoters of the association regard the time as opportune, because of the coal strike, the high cost of living, and the newsprint shortage." The promoters of the enterprise were manufacturers, scientists, publishers, bankers, and leaders in industries.

SOIL SURVEY—The State Geological Survey has for a number of years been conducting a detailed soil survey of the state. Nearly half the counties have been surveyed and mapped. This is an important and necessary work, and the maps are useful for many purposes besides those strictly agricultural. In the absence of topographic base maps this work has moved along slowly. With these maps already available, the soil mapping of Mississippi would have been completed several years ago. The topographic survey should precede the soil survey, furnishing an accurate contour map upon which the soil distribution could be plotted as studied. As a preliminary to soil study, a topographic survey is a great desideratum, besides, which, topographic maps have a much wider field of usefulness than our present soil maps.

EDUCATIONAL—The interpretation of topographic maps should not be confined to the technical engineer or geologist. They are so widely useful in all activities connected with the surface contour of the land that an intelligent use of them should be very general among the people. This has become so evident that in most parts of the country the study of these maps is an important part of high school and college work. The physical history of a region is indellibly written in its surface contours. The civic and industrial development of a region is affected very directly by its surface characteristics. This is a well recognized fact, so that the physical geography, the industrial and intellectual development of the inhabitants, and, to a great extent, the political history of a region are studied now largely in the light of its surface configuration.

Accurate contour maps would be of inestimable value

used in our schools in connection with the study of the geography, geology, history, and industrial development of the state.

MINERAL AND OIL DEVELOPMENT—All accurate and detailed mapping of mineral deposits of any nature must be done on topographic base maps. This is particularly true of oil and gas. The search for oil and gas resolves itself usually into a search for certain geologic structures that are associated with the occurrence of these minerals and determine their accumulation in commercial quantities.

Under these structures, anticlines, monoclines, domes, etc., oil and gas accumulate in so-called pools; in the absence of these structures no oil or gas in commercial quantities may usually be looked for, hence, the necessity of locating an anticline, dome, or other known oil structure before undertaking the expensive experiment of drilling for oil or gas.

To discover and outline an anticline or dome requires detailed topographic work. With an accurate topographic base map of a region to be investigated, the location of these structures can usually be made out without difficulty. In fact, not infrequently, especially in the case of salt domes on the low coastal lands, the topographic map will itself show the presence of the dome and determine its outline.

All oil geologists recognizing the value of a topographic map of a region to be investigated for oil structures, always provide themselves with one, if it is available, before beginning their search for oil structures.

In all the sections of Texas where oil development has been most active, the region had been previously mapped, and the oil geologist used these maps in the investigation for oil structures. Dr. Udden, of the Geological Survey of Texas, says that those counties that had been previously mapped received the greatest development.

Mississippi has had only 4% of its surface mapped by topographic survey, and hence the search for oil structures

has not been as satisfactory as it doubtless would be if the state had been more largely mapped. We have never undertaken a topographic survey of the state because of lack of funds sufficient to do so. We firmly believe that such a survey will promote a lively search for oil structures in this state. There appear to be no sufficient geological reasons why Mississippi should not produce oil. A topographic survey will facilitate and promote investigation for oil and gas, and if we have it in the state, there is every reason to believe it will be found. If the state has oil and gas, it must be discovered and made productive, so that we may enjoy the prosperity that now is enriching our neighbor states.

HEALTH AND SANITATION—A health and sanitary survey would have to be in a large measure based upon topographic features of the state which are accurately delineated upon topographic maps. The distribution of malaria, hookworm disease, tuberculosis, and to a less extent, other diseases, is closely related to soil conditions, which in turn depend largely upon topography. Hence an accurate topographic survey, by furnishing a key to the surface features, will show rather definitely the regions which would furnish favorable starting points for the spread of those diseases. Having located the spots where the danger lies, measures could readily be taken to combat the enemy in his lair.

How Can a Topographic Survey Be Obtained?

In October (1919) I wrote to the Director of U. S. Geological Survey, wishing to know to what extent that Department would co-operate with the Mississippi Geological Survey in the event the Legislature should appropriate funds for a topographic survey of the state. I received in reply a statement, the closing paragraph of which is as follows: "I hope that you will be able to secure a substantial state appropriation from the next Legislature. If Congress appropriates \$600,000 for topographic surveys for the next fiscal year, as has been asked in the Director's estimate, the Geological Survey will be able to meet any amount of Mississippi funds up to about \$20,000. You can therefore see that by appropriating \$20,000 per year the state will receive the benefit of topographic work costing \$40,000 per year." In other words, the United States Geological Survey will duplicate any amount provided by the state for the work, the maximum being \$20,000, and the minimum, according to usual practice, being \$5,000 per year.

Under the co-operative arrangement the work will be under the direct supervision of the Topographic Branch of the U. S. Geological Survey, and the work will be as accurate as can be made.

Testimony of Others on the Value of a Topographic Survey.

On the same date when I wrote the Director of the U. S. Geological Survey, I addressed a letter to each State Geologist throughout the United States, asking for a statement of his opinion as to the usefulness of a topographic survey to a state. The replies were too long to print in full, but an extract or a summary, giving the gist of each letter, appears below:

Dr. E. A. Smith, State Geologist of Alabama, says: "I can think of nothing more sorely needed, both in Alabama and Mississippi, than these topographic maps There are no maps made which, in this country compare with the U. S. Topographic maps The topographic maps can be used by engineers for the preliminary location of railroads and highways and drainage canals, and for these uses alone the maps would be worth to the people far more than they cost. It appears hardly worth while to enumerate the many ways in which such maps can be of service."

Dr. N. F. Drake, State Geologist of Arkansas: "There is no doubt that good topographic maps are essential to the discussion of geology, and to a clear presentation of any geological features. . . Topographic maps surely should precede geological work."

Dr. F. McN. Hamilton, State Mineralogist of Cali-

fornia: "There is of course, no question as to the value of topographic surveys in connection with the industrial development of any country, and I wish you all success in your efforts to broaden your present field of usefulness."

Dr. R. D. George. State Geologist of Colorado, summarizes as follows: "It is almost impossible to over emphasize the value of accurate topographic maps. . . . Their usefulness extends to Irrigation projects, accurately showing the features of the areas to be irrigated; most feasible routes for canals, reservoir sites, flume sites, etc., water power development, giving fall of streams, constancy or intermittancy of flow; sites for dams, etc.; Mine development, locating mineral deposits; surface features affecting transportation: water power sites. etc.: Geological mapping. accurate location of valuable mineral deposits with a view to development: accurate determination of geological structures, etc.; Road Building, educational, giving exact maps of the state, showing surface features, valuable for use in schools and colleges of the state." (The above is summarized from Prof. George's letter.)

Dr. Herman Gunter, State Geologist of Florida, writes: "In this systematic work (Geological Survey work) there is nothing more helpful than accurate, detailed, topographic maps. . . Topographic maps such as are now issued by the U. S. Geological Survey are the last word in mapmaking. . . These maps are invaluable in the study of the mineral resources, and for all geologic work. . . . in the preparation of detailed soil maps. . . , in the laying out of a system of highways, and in the location of railways, canals, and other general improvements. . . It should be the purpose of each state in the Union to cooperate with the Federal Government in the preparation of these maps."

Dr. S. W. McCallie, State Geologist of Georgia: "I regard these maps as indispensable to high grade geological work. In other words, no state can hope to have a reliable geological report made on the state as a whole unless this work is preceded by topographic mapping. Topographic maps are also of great value in laying out and constructing highways, as well as in the development of the water powers of the state."

Dr. F. W. DeWolf, State Geologist of Illinois: "While the topographic maps are designed chiefly to serve geological investigations, they are useful in highway engineering, drainage engineering, and other lines of work." (Dr. DeWolf referred to an abstract of opinions of various State Highway Engineers, which was prepared in his office, and which expressed substantially his views. This has been referred to in connection with the Government position on the subject.)

Dr. Wm. N. Logan, State Geologist of Indiana: "T consider topographic mapping of great importance to the state. In the first place, it is very essential in conducting the work of the geological and soil survey; the mapping of geological formations and mapping of soils can be accomplished with a great deal less expense if topographic maps are available for the use of the geologist and soil expert. Topographic maps are also of great value in promoting the work of the Highway Commission. If topographic maps are available, the Highway Engineer can readily prepare profiles upon which he can base estimates of the cost of completing the highways. They are of value in nearly all lines of industrial work, such as railroads, steamship lines on navigable rivers, water power plants, drainage projects, forestry work, lumber and reforestration, the development and securing of underground water for domestic supplies. . I know of no investment along scientific lines that the Legislature of Mississippi could make that would in the end, bring larger returns to the state."

Dr. Geo. F. Kay, State Geologist of Iowa: "I do not hesitate to state that topographic maps are very essential in connection with the development of any state. I feel sure that if we had topographic maps of the whole of our state we would be able to save hundreds of thousands of dollars within the next few years, during which time we will be carrying forward an extensive program of good roads, drainage, building of bridges, and many other phases of work related to the development of the state."

Dr. R. C. Moore, State Geologist of Kansas: "The value of accurate topographic maps can hardly, I think, be overestimated. Not only are they the basis for much of engineering development, but also, as brought out emphatically in the proceedings of the Engineering Council, (copy of which has no doubt been forwarded to you) they are the basis for most of the scientific work carried on by the state, and furnish final and complete data as to roads and the general nature of the country. . . I think, in view of the very emphatic recommendations of the Engineering Council as to the stand that should be taken by the mapping agencies of the Federal Government, that the need of a complete and accurate topographic map of every state is now well recognized."

Dr. J. E. Barton, Commissioner of Geology of Kentucky: "This work is of inestimable value from several standpoints. First, in connection with the mineral development of the state, particularly in oil development, the demand for these maps has been enormous, and it is the keen regret of this office that so small a portion of the state in which oil development has taken place is covered by accurate and recent topographic surveys.

Second, in the enormous road development which is going forward at the present time, topographic surveys are of the most vital importance.

Third, topographic surveys are essential in connection with the water power development within the state.

Fourth, as a part of the general war preparedness of the United States, the value of such maps cannot be overestimated."

Dr. W. B. Mathews, State Geologist of Maryland: "I am glad to learn that there are prospects of your inaugurating a Topographic Survey in co-operation with the U. S. Geological Survey. There can be no question as to the benefits derived by the inauguration of such work. We have found it of continuous and constantly increasing value along many lines. . . The benefits derived far exceed the cost of the work by the reduction of costs in practically every state agency and public movement, such as highway and health surveys and social and ecclesiastic campaigns."

Dr. R. A. Smith, Acting State Geologist of Michigan: "Topographic maps and the bench marks eliminate the cost of many preliminary surveys in road-making. They are especially useful in laying out routes for trunk lines, roads, new roads, railroad lines, etc. Such maps are essential to military operations, both offensive and defensive.

"The topographic survey is also a very important aid to agricultural development, because it makes possible the correlation of field study, and mapping of soils with respect to topography and drainage. It is particularly valuable to the development of artificial drainage. . . For the proper solution of water, sewer, and drainage problems of cities and villages topographic surveys are almost indispensible, and likewise for the general investigation of stream flow, stream gaging, flood control, water powers, etc. . . These maps are especially valuable for plotting investigations bearing on the geologic and mineral resources of the state."

Dr. A. G. Leonard, State Geologist of North Dakota: "There can be no doubt about the great value of topographic surveys. In connection with the building of highways, they save the state and Federal Governments much more than their cost by furnishing data, which, without topographic maps, could be secured only at much expense. These maps are needed in planning irrigation and drainage systems. They are essential in many public works, such as the construction of reservoirs, and the development of water supply projects. The development of water powers also requires such maps. Their educational value is also great, and their use in the schools is constantly increasing." Dr. J. A. Bownocker, State Geologist of Ohio: "No matter what kind of scientific work one is doing, whether it is railroad, traction line, or canal planning, geological survey, natural history survey, soil survey, or, in fact, as just stated, any other kind of scientific work, the first thing asked for is an accurate map. We have been using the topographic sheets in Ohio for about 20 years, and have found them invaluable. In fact, it is difficult to understand how we could get on without them, and at the same time do high grade work."

Dr. Henry M. Parks, Director of the Oregon Bureau of Mines and Geology: "The State Bureau of Mines and Geology has always been a staunch supporter of more and better topographic surveys in our states. A topographic survey is the very basis of detailed geologic work."

Dr. Stephen Taber, of Department of Géology, University of South Carolina: "I regard the topographing mapping of our country as of the greatest importance. The maps are necessary for accurate geologic work, and may be used in solving drainage problems, in the location of highways and water supply, and for many other purposes."

Dr. Freeman Ward, State Geologist of South Dakota: "There is no doubt that topographic maps would greatly aid our survey work here.

They would aid in all matters concerning boundaries, elevations, and problems of location. They would save us many preliminary surveys dealing with road construction, drainage conditions, water power sites, and all similar engineering problems. We need them especially for geological field work, not only as guides for getting about and recording data graphically, but particularly for threedimensional problems of structure and stratigraphy, and all problems depending upon them."

Mr. Wilbur A. Nelson, State Geologist of Tennessee: "We can give specific instances in Tennessee where, if we had topographic maps, we could have saved the state and private interests considerable money. In the work of the State Highway Department the absence of topographic maps has entailed on the Department large additional expense in preliminary surveys. . . In East Tennessee the lack of maps has laid an additional burden on every land owner in every drainage district, due to added engineering cost necessary to installing the drainage district."

Dr. J. A. Udden, Director of the Bureau of Economic Geology at the University of Texas: "I can say for this state that the topographic maps published by the United States Geological Survey, have been of great value in the oil development within the last two years. Naturally those who are interested in oil development prefer to go to parts of the state that are covered by good maps."

Dr. Geo. H. Perkins, State Geologist of Vermont: "I am sure there can be no doubt in the minds of our intelligent citizens that the topographic maps in a few years save their cost, and ultimately, many times their cost."

Dr. Thomas L. Watson, State Geologist of Virginia: "The data furnished by the maps resulting from topographic surveys are so varied as to make them useful in nearly every public and private activity having to do with the surface of the land. They are of practical value in planning engineering projects, improvement of highways, construction of electric and steam railways, and in studying the sewage and water supplies of cities. They are of the highest economic importance as a means of showing the location, extent and accessibility, of lands, waters, forests, and mineral resources. Their main importance, however, is as a base upon which to study the geologic formations. and the relation of the coal, oil, gas-bearing formations, one to the other, their depth below the surface, and the probable extension of such resources into unexploited areas."

Dr. I. C. White, State Geologist of West Virginia: "Concerning the value of topographic work to any State, I would say that West Virginia has found it of enormous advantage to every interest, mineral, municipal, agricultural, and especially valuable to the Commissioners of our County Courts, who have the laying out of roads, the building of bridges, improving of grades of roads already built, locating new roads, and every department of state, county, and municipal activity. . . . The people of Mississippi, in which state so much land needs draining, and since no drainage undertakings can be intelligently inaugurated except after careful surveys and accurate levels are made, will commit no mistake by inaugurating and properly supporting a co-operative topographic survey to cover the entire State of Mississippi."

Dr. W. O. Hotchkiss, State Geologist of Wisconsin, after making a general statement of the great values of topographic surveys stating some specific instances of financial loss for lack of them in parts of Wisconsin, says: "I am somewhat familiar with certain parts of Mississippi, having been engaged in railroad construction work there many years ago, and from what knowledge I possess of the state, I can say that these maps would be of very great value in connection with drainage and highway problems. Your state has possibilities, which few people appreciate, and a good topographic map would be one of the cheapest and most accurate ways of presenting these possibilities to those whom the state hopes to attract to make this development."

Dr. B. G. Morgan, State Geologist of Wyoming: "This work is of inestimable value to the state. . . . Topographic maps are of great assistance in geological work, especially in the study and investigations of oil fields and mineral deposits. . . Too much importance cannot be attached to the need of topographic surveys."

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