

GEOLOGY OF THE REPUBLIC OF HAITI.

By WENDELL P. WOODRING, JOHN S. BROWN, and WILBUR S. BURBANK.

INTRODUCTION.

By WENDELL P. WOODRING.

ARRANGEMENTS FOR THE RECONNAISSANCE.

On March 24, 1917, Hon. Frank L. Polk, Acting Secretary of State of the United States, addressed a letter to Hon. Franklin K. Lane, Secretary of the Interior, calling attention to Article I of the treaty of September 16, 1915, between the United States and the Republic of Haiti, which provides that the Government of the United States will by its good offices aid the Haitian Government in the proper and efficient development of its agricultural, mineral, and commercial resources, and inquired whether it would be practicable for the United States Geological Survey to make a geological reconnaissance of the Republic of Haiti. In reply the Secretary of the Interior stated that the Geological Survey would cooperate by furnishing the scientific personnel, but that it had no authority under which any part of the appropriations made by Congress for its maintenance could be expended outside the territorial limits of the United States. In later correspondence estimates of the expenditures necessary for a geological reconnaissance were submitted by the Secretary of the Interior.

In the summer of 1919 plans for the reconnaissance submitted by the Director of the United States Geological Survey were approved by the Secretary of State for Public Works of the Republic of Haiti and by Hon. John A. McIlhenny, Financial Adviser to the Haitian Government, and Commander E. R. Gayler, C. E. C., U. S. N., Engineer in Chief of the Department of Public Works.

In the meantime field work had been begun for a geological reconnaissance of the Dominican Republic under the supervision of the United States Geological Survey. Dr. T. W. Vaughan, of the United States Geological Survey, who was in charge of the work in the Dominican Republic, made an inspection trip from Ouanaminthe to Port-au-Prince and return in order to make more effective plans for the field work in the Republic of Haiti.

The appropriation for the reconnaissance was made by the Council of State. The field work was delayed until the fall of 1920 in order that all

the information contained in the complete report on the geology of the Dominican Republic might be used to the greatest advantage. The final arrangements for the work were made with Commander A. L. Parsons, C. E. C., U. S. N., who succeeded Commander Gayler as Engineer in Chief.

FIELD WORK.

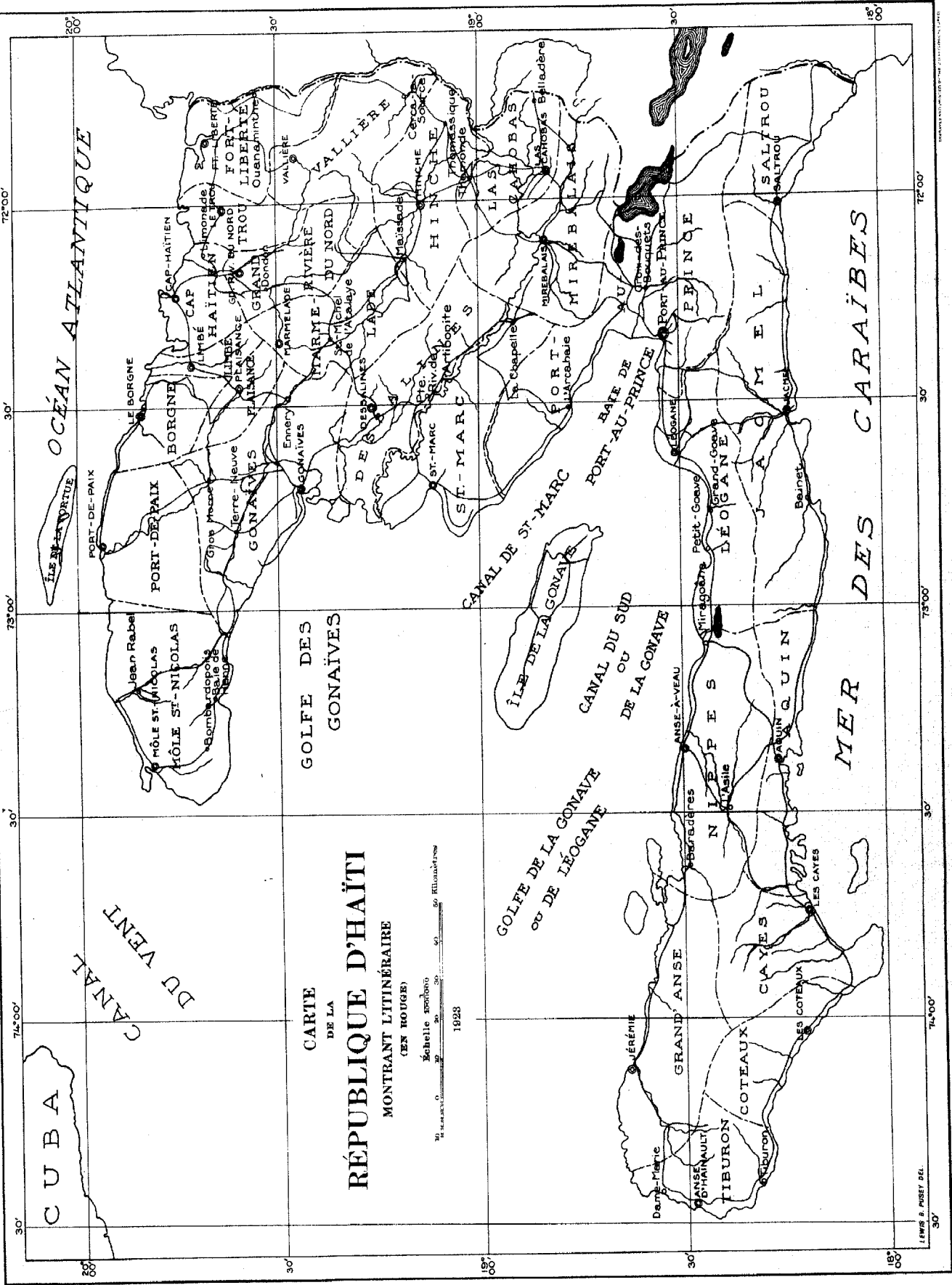
Messrs. John S. Brown, Wilbur S. Burbank, Frank G. Evans, jr., and I arrived in Port-au-Prince on October 1, 1920. We spent the succeeding six and a half months in the field and sailed from Port-au-Prince on April 15, 1921. During most of the time we spent in the field we worked in two parties, traveling by automobile, on horseback, and on foot along the routes shown in Plate III and mapping the geology as we traveled, thus making a reconnaissance survey of almost the entire Republic, including Gonave and Tortue islands. General geologic work was done by all the members of the expedition, but Mr. Brown gave particular attention to the underground-water resources and to the field relations of the mineral deposits and igneous rocks, Mr. Burbank examined the mineral deposits and the igneous rocks, and I studied the stratigraphy and stratigraphic paleontology and the lignite and oil resources.

A detailed reconnaissance of several regions was made in order to ascertain the extent of the mineral deposits and the possibility of utilizing the underground-water resources. We had no adequate base map. The triangulation, which was under the supervision of Mr. Glenn S. Smith, of the United States Geological Survey, designed to provide a base for a topographic survey of the Republic, had not progressed far enough to permit us to utilize the results. We used the charts of the Hydrographic Office of the United States Navy for mapping regions near the coast, and we used also the maps of M. L. Gentil Tippenhauer, of Port-au-Prince, which cover some parts of the Republic. In other regions we were forced to rely on rough notebook sketches, in which distances were estimated only by the time consumed in traveling. Unless otherwise stated, altitudes are based on aneroid readings.

While we were in the field Mr. Brown prepared and submitted reports on the public water supply of Port-au-Prince and of Cap-Haïtien. We also prepared a report suggesting improvements in the water supply of some towns and villages, particularly those that now depend on salty water for their principal supply. These preliminary reports have been amplified and included in this volume.

OFFICE WORK.

As soon as we returned to Washington we began to write the text of this report, to examine the collections, and to prepare maps and other illustrations. The original agreement provided that the collections should be deposited in the United States National Museum, but that if a national



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MONTRANT L'ITINÉRAIRE
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museum should be established at Port-au-Prince a duplicate set would be sent there.

The extensive collections of fossils were examined by the following paleontologists: Corals, Dr. T. W. Vaughan, of the United States Geological Survey; Crinoidea, Dr. Frank Springer, of the United States National Museum; Echini, Dr. R. T. Jackson, of Peterborough, New Hampshire; Bryozoa, Dr. R. S. Bassler, of the United States National Museum; Cretaceous Mollusca, Dr. T. W. Stanton, of the United States Geological Survey; Cirripedia, Dr. H. A. Pilsbry, of the Philadelphia Academy of Natural Sciences; decapod Crustacea, Dr. Mary J. Rathbun, of the United States National Museum; fish, Prof. T. D. A. Cockerell, of the University of Colorado; birds, Dr. Alexander Wetmore, of the Biological Survey, United States Department of Agriculture; mammals, Mr. G. S. Miller, jr., of the United States National Museum; plants, Prof. E. W. Berry, of Johns Hopkins University. I undertook the examination of the larger Foraminifera, and in collaboration with Mr. W. C. Mansfield, of the United States Geological Survey, the examination of the Tertiary and Quaternary Mollusca and Brachiopoda. The smaller Foraminifera and several collections of ostracods and calcareous algae have not been examined.

Chemical analyses of igneous rocks were made by Dr. H. S. Washington, of the Carnegie Institution of Washington. Samples of ore and of raw material for cement were analyzed in the chemical laboratory of the United States Geological Survey under the direction of Mr. George Steiger, chief chemist. Other samples of ore were analyzed and assayed by Ledoux & Co., of New York. Mr. E. V. Shannon, of the United States National Museum, analyzed a sample of kaolinite. Samples of lignite were analyzed at the Pittsburgh Laboratory of the United States Bureau of Mines. Samples of rock and other road material, and samples of sand and gravel for making concrete were tested by the Bureau of Public Roads, United States Department of Agriculture. Samples of clay for making brick were tested at the ceramic station of the United States Bureau of Mines at Columbus, Ohio. Analyses of guano were made by the United States Department of Agriculture. Analyses of samples of water were made in the water-resources laboratory of the Geological Survey under the direction of Mr. W. D. Collins.

A preliminary account of the possible oil resources of the Central Plain was published in July, 1922. A brief summary of the results of the reconnaissance was published in the *Journal of the Washington Academy of Sciences* in April, 1923. These and other papers describing collections obtained during the reconnaissance or setting forth some of its results are listed below:

BERRY, E. W., Tertiary fossil plants from the Republic of Haiti: *U. S. Nat. Mus. Proc.*, vol. 62, art. 14, 10 pp., 1 pl., 2 text figs., 1922.

- COCKERELL, T. D. A., A fossil cichlid fish from the Republic of Haiti: U. S. Nat. Mus. Proc., vol. 63, art. 7, 2 pp., 1 pl., 1923.
- MILLER, G. S., JR., Remains of mammals from caves in the Republic of Haiti: Smithsonian Misc. Coll., vol. 74, No. 3, 8 pp., 1922.
- PILSBRY, H. A., Miocene Cirripedia from the Republic of Haiti: U. S. Nat. Mus. Proc. (Awaiting publication.)
- RATHBUN, M. J., Fossil crabs from the Republic of Haiti: U. S. Nat. Mus. Proc., vol. 63, art. 9, 6 pp., 2 pls., 1923.
- SPRINGER, FRANK, A new Tertiary crinoid in the West Indies: U. S. Nat. Mus. Proc. (Awaiting publication.)
- WETMORE, ALEXANDER, Remains of birds from caves in the Republic of Haiti: Smithsonian Misc. Coll., vol. 74, No. 4, 4 pp., 2 text figs., 1922.
- WOODRING, W. P., Middle Eocene Foraminifera of the genus *Dictyoconus* from the Republic of Haiti: Washington Acad. Sci. Jour., vol. 12, pp. 244-247, 1922.
- Stratigraphy, structure, and possible oil resources of the Miocene rocks of the Central Plain: Republic of Haiti Geol. Survey, 19 pp., map, 1922.
- Tectonic features of the Republic of Haiti and their bearing on the geologic history of the West Indies (abstract): Washington Acad. Sci. Jour. (Awaiting publication.)
- An outline of the results of a geological reconnaissance of the Republic of Haiti: Washington Acad. Sci. Jour., vol. 13, pp. 117-129, 1923.
- Tertiary mollusks of the genus *Orthaulax* from the Republic of Haiti, Porto Rico, and Cuba: U. S. Nat. Mus. Proc.: vol. 64, art. 1, 12 pp., 2 pls., 1923.

ACKNOWLEDGMENTS.

In the field work and in the preparation of the report we have had the unfailing support and encouragement of Commander Parsons, under whose direction the work was done. The field work and most of the office work was done under the supervision of Dr. T. W. Vaughan while he was chief of the sections of Coastal Plains investigations and of West Indian Geological Surveys of the United States Geological Survey. Doctor Vaughan has reviewed the entire report, and we have thus had the advantage of his wide knowledge of the geology of the West Indies and regions near by. We wish to record our deep appreciation of the services of Rev. J. Scherer, Directeur de l'Observatoire Météorologique du Séminaire-Collège St.-Martial. In an unassuming way and almost without the knowledge of the general scientific world he has for years been collecting and publishing invaluable meteorological and seismological data. The matter on climate and earthquakes in this report could not have been written without M. Scherer's records. We have used with great advantage the published geologic maps of M. L. Gentil Tippenhauer, of Port-au-Prince. Only those who have traversed the rugged mountains of the Republic can appreciate the labor that these maps represent. Mr. E. L. McNair, in charge of the triangulation party, and the engineers of the Department of Public Works cooperated with us in every way. Mr. R. A. Conard, engineer of the Haytian-American Sugar Co., furnished logs of wells in the Cul-de-Sac Plain and other information concerning them. Mr. Frank G. Evans, jr., one of the members of the party, gave valuable