

OIL.

POSSIBLE OIL RESOURCES OF THE CENTRAL PLAIN.

No wells have been drilled in the Republic of Haiti to ascertain the possibility of obtaining oil in commercial quantities. The detrital Miocene rocks are the most favorable beds, both as mother rocks and as reservoirs. These rocks attain their maximum thickness in the Central Plain. An account of the possible oil resources of the Miocene rocks of the Central Plain has already been published,¹ and the following paragraphs are taken from this account.

STRATIGRAPHY OF THE MIOCENE ROCKS.

The Miocene rocks of the Central Plain, or Artibonite group, consisting in ascending order of the Madame Joie formation, Thomonde formation and Maïssade tongue, and Las Cahobas formation, have an estimated thickness of 1,400 meters. Their stratigraphy is fully discussed on pages 161-206, and their distribution is shown on Plate XXXVI.

STRUCTURE OF THE CENTRAL PLAIN.

Structurally the Central Plain is a large southeastward-plunging syncline, modified by secondary anticlinal and synclinal folds, between the Massif du Nord and the Montagnes Noires. The axis of the syncline trends northwestward, parallel to the structural trend of the mountains.

NORTHWESTERN PART.

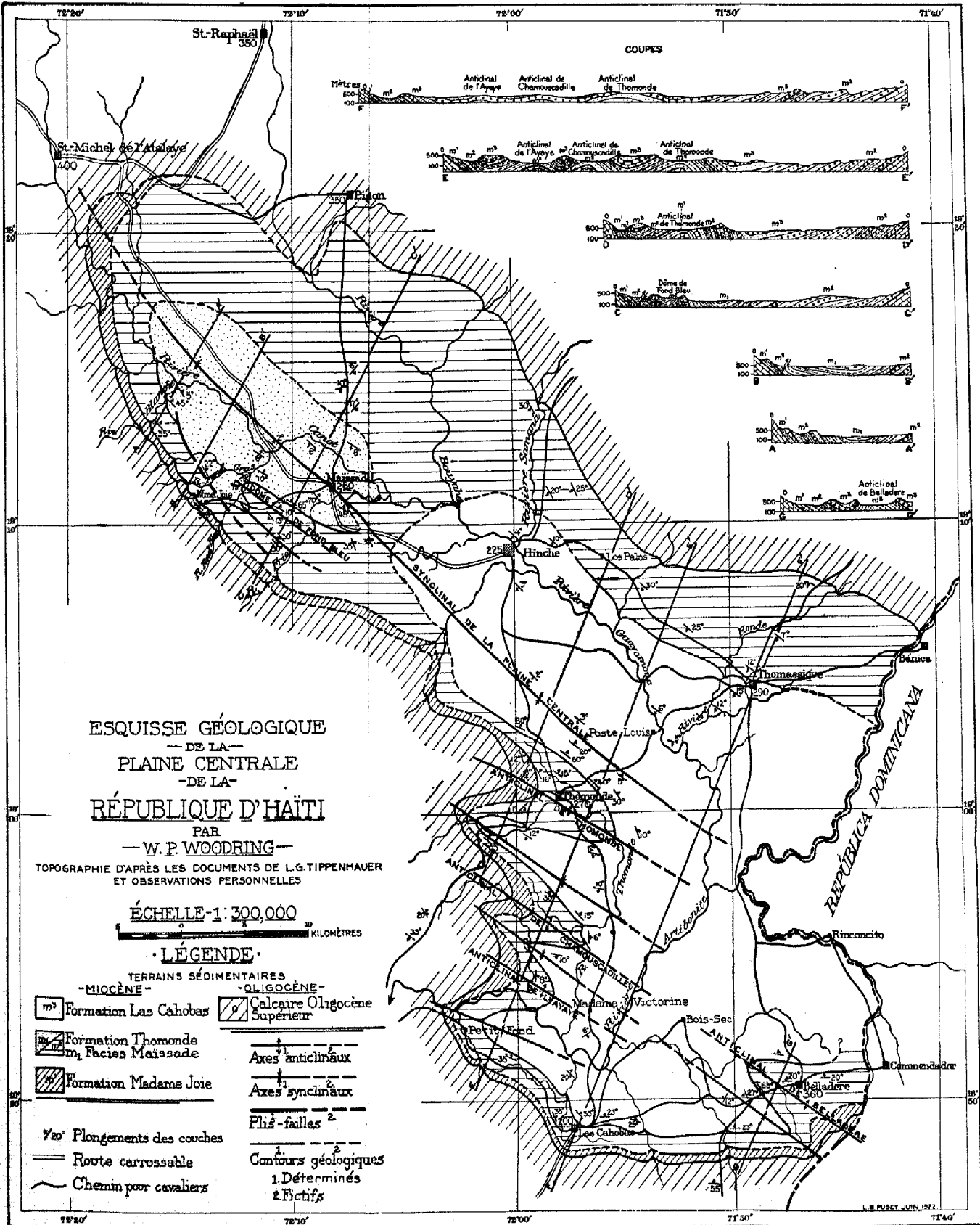
Southwest limb of syncline.

The northwestern part of the plain is an asymmetrical syncline that has steeper dips on the southwest limb than on the northeast limb. (See Pl. XXXVI, section *A-A'*.) The structure of the southwest limb is modified by secondary anticlinal and synclinal folds and by thrust faults.

FOND BLEU DOME.

The anticlinal fold on the southwest limb of the syncline, which apparently plunges both northwestward and southeastward, is called the Fond Bleu dome, from the name of the stream flowing across its northwest end. The crest of the dome is about 3.5 kilometers in an air line southwest of the town of Maïssade, or about 4.8 kilometers west-southwest of Maïssade by the trail to Madame Joie. The dome is asymmetrical and has steep dips to the northeast, toward the main synclinal trough, except for a distance of 0.5 kilometer from the crest, where the dips are relatively gentle. (See Pl. XXXVI, section *C-C'*.) Farther northeast for 0.6 kilometer the dip is as high as 65°. Northeast of this narrow belt of high dips the beds

¹ Woodring, W. P., Stratigraphy, structure, and possible oil resources of the Miocene rocks of the Central Plain, 19 pp., map, Rep. Haiti Geol. Survey, 1922.



ESQUISSE GÉOLOGIQUE
— DE LA —
PLAINE CENTRALE
— DE LA —
RÉPUBLIQUE D'HAÏTI

PAR
— W. P. WOODRING —
TOPOGRAPHIE D'APRÈS LES DOCUMENTS DE L.G. TIPPENHAUER
ET OBSERVATIONS PERSONNELLES

ÉCHELLE-1: 300,000
KILOMÈTRES

• LÉGENDE •

- TERRAINS SÉDIMENTAIRES - OLILOCÈNE -
- Formation Las Cahobas
 - Formation Thomonde
 - Formation Madame Joie
 - Calcaire Oligocène Supérieur
 - Axes anticlinaux
 - Axes synclinaux
 - Fliè-failles
 - 70° Plongements des couches
 - Route carrossable
 - Chemin pour cavaliers
 - Contours géologiques
 - 1. Déterminés
 - 2. Fictifs

flatten in a short distance and dip at the rate of about 6° to the trough of the main syncline, which lies about 3.7 kilometers northeast of the crest of the dome. In the trough of the syncline the beds are probably 400 meters lower structurally than on the crest of the dome. On the southwest limb the beds dip from 5° to 30° for 1.5 kilometers from the crest and flatten in the trough of a narrow, sharply folded syncline that separates the dome from the mountain front. The southeastern part of the dome was not examined, but apparently the area of closure is about 5 kilometers long and has a maximum width of 1.5 kilometers.

The lowest rocks exposed on the crest of the dome are sandstones and siltstones in the lower part of the Thomonde formation. The conglomerates and coarse sandstones in the middle part of the Thomonde formation form a "rim rock" around the dome.

Between the syncline southwest of the dome and the mountain front the lowest beds in the Thomonde formation are probably thrust northeastward over higher beds in the Thomonde formation. Farther northwest the lower part of the Thomonde formation is thrust northeastward over the Maïssade tongue. (See Pl. XXXVI, section *B-B'*.) More extensive thrust faults may separate the older limestones from the detrital Miocene rocks along the mountain front, but the mountain front was not examined.

Northeast limb of syncline.

PLUNGING ANTICLINE BETWEEN MAÏSSADE AND PIGNON.

The southeastward extension of the Oligocene rocks along Rivière Bouyaha and the strikes and dips recorded in the Miocene beds along the trail between Maïssade and Pignon indicate that a southeastward-plunging anticline extends into the plain on the northeast limb of the syncline. This anticline parallels a southeastward-plunging secondary syncline to the east, which accounts for the northwestward extension of Oligocene beds beyond St.-Raphaël.

SOUTHEASTERN PART.

Southwest limb of syncline.

In the enlarged southeastern part of the plain the southwest limb of the main syncline is much wider than the northeast limb and is characterized by asymmetrical anticlines that emerge from the mountains and plunge into the plain.

WEST SIDE.

On the west side of the plain a bulging compound anticline strikes off from the mountains. Three asymmetrical anticlines are superimposed on this compound anticline and plunge southeastward into the plain. All the anticlines have steep northeastward dips and more gentle south-

westward dips. The crests of the anticlines are approximately parallel to one another and to the trough of the main syncline.

Thomonde anticline.—The northern anticline is the largest of the three folds. It was called the Thomonde anticline by Jones,¹ as the town of Thomonde stands near its crest. The crest of the anticline extends for an unknown distance southeastward into the plain. The rate of plunge of the crest is about 8° near the mountains, but it decreases southeast of Thomonde. The fold is sharply asymmetrical near the mountains (see Pl. XXXVI, section *D-D'*), but the northeastward dip decreases markedly in a short distance out toward the plain, and the fold becomes virtually symmetrical southeast of Thomonde (see Pl. XXXVI, sections *E-E'* and *F-F'*). The beds on the northeast limb dip from 5° to 20° for a distance of 1.8 kilometers from the crest. Near the mountains the northeast limb steepens abruptly farther from the crest—for example, on the trail from Thomonde to Hinche there is a belt about 0.5 kilometer wide where the dip is from 70° to 80° or even 90°. Northeast of this belt of steep dips the beds flatten rapidly toward the trough of the main syncline. Southeast of the trail from Thomonde to Hinche the northeast limb is not so steeply tilted. North of Thomonde the steepest dips are from 40° to 60°, and northeast of Thomonde, on the trail to Thomassique, the maximum dips are 30° to 40°. (See Pl. XXXVI, section *E-E'*.) Still farther to the southeast the dip of the beds on the northeast limb is more gentle as the fold plunges into the plain. (See Pl. XXXVI, section *F-F'*.) The trough of the main syncline lies about 4.5 kilometers northeast of the crest of the anticline. In the trough of the syncline the beds are about 800 meters lower structurally than on the crest of the anticline at Thomonde. The beds on the southwest limb dip southwestward at a rate of 5° to 12° to the trough of a shallow plunging syncline.

Successively older rocks arch over the crest of the anticline northwestward toward the mountains. The conglomerates at the base of the Las Cahobas formation form a conspicuous pine-covered "rim rock" around the southeastern part of the anticline.

Chamoussadille anticline.—The middle one of the three plunging anticlines on the west side of the plain is called the Chamoussadille anticline, from the name of the rural section in which it is situated. The Chamoussadille anticline resembles the Thomonde anticline in many features, but it plunges more steeply into the plain. The crest of this anticline is about 7 kilometers southwest of the crest of the Thomonde anticline and about 3 kilometers southwest of the trough of the shallow syncline between the two anticlines. (See Pl. XXXVI, section *E-E'*.) Along the trail from Las Cahobas to Thomonde the crest plunges southeastward at the rate of about 6°. Near this trail the dip of the beds on the northeast limb is 10°.

¹Jones, W. F., *A geological reconnaissance in Haiti; a contribution to Antillean geology*: Jour. Geology, vol. 26, p. 736, 1918.

Toward the mountains the dip of the beds on the northeast limb increases markedly; along the trail from Thomonde southwestward across the mountains to Mirebalais it is 55° . On the southwest limb the beds dip from 5° to 10° for a distance of about 2 kilometers to the trough of a shallow plunging syncline similar to the syncline on the northeast side of the anticline.

Conglomerates at the base of the Las Cahobas formation form a "rim rock" around the southeastern part of the anticline, as on the Thomonde anticline.

Ayaye anticline.—The southernmost of the three anticlinal folds is called the Ayaye anticline, from Rivière l'Ayaye, which flows across its crest. This anticline is the shortest and least conspicuous of the three plunging anticlines on the west side of the plain. Its crest is about 3.8 kilometers southwest of the crest of the Chamouscadille anticline and about 1.8 kilometers southwest of the intervening shallow syncline. The trough of the syncline between the Ayaye anticline and the mountains on the south side of the plain is about 3.5 kilometers southwest of the crest of the anticline. The crest plunges southeastward at the rate of 8° where Rivière l'Ayaye crosses it. This anticline is apparently not so asymmetrical as the other two, but the dips on the limbs were not measured.

SOUTH SIDE.

Belladère anticline.—On the south side of the plain near the Dominican border an asymmetrical anticline emerges from the mountains and plunges northwestward into the plain. This fold is called the Belladère anticline, as the town of Belladère is on its north limb. The Belladère anticline may be the prolongation of the Chamouscadille anticline, but it is not known whether the fold extends across the interior of the plain, and the topographic base map is not so accurate for this part of the plain as for the area farther west. The Belladère anticline resembles the plunging anticlines on the west side of the plain in many features, but it differs from them in having steep dips on the southwest limb and more gentle dips on the northeast limb. (See Pl. XXXVI, section *G-G'*.) The crest of the fold is about 2.5 kilometers northeast of the trough of a narrow, sharply folded syncline that widens as it plunges into the plain. On the crest of the anticline the beds are not well exposed, but southwestward from the crest the dip of the beds on the southwest limb increases to 55° in a distance of about 1 kilometer. The dip on the northeast limb was measured only near Belladère, where the beds dip from 10° to 20° almost due north.

A high "rim rock," formed by the basal beds of the Las Cahobas formation, incloses the northwestern part of the anticline, as on the plunging anticlines on the west side of the plain.

Northeast limb of syncline.**STRUCTURAL TERRACE NEAR THOMASSIQUE.**

On the northeast limb of the syncline the beds dip southwestward toward the trough. Along the trail from Thomonde to Thomassique they rise from the trough of the syncline at a rate of dip that increases rather uniformly to 15° or 20° near Thomassique. (See Pl. XXXVII, A.) Northeast of Thomassique there is a belt about 4.5 kilometers wide where the dip flattens to 7°. Farther northeast the beds are upturned against the mountains in a belt about 3 kilometers wide, where the dip is as high as 20°. This structural terrace coincides with the wider part of the plain.

POSSIBLE SOURCE OF OIL.

The Thomonde formation is the most promising possible source of oil in the Central Plain. Beds in this formation, especially in its middle and upper parts, contain the remains of a great variety of marine organisms. The Maïssade tongue, which is a coastal-swamp facies of the middle and upper parts of the Thomonde formation, contains an abundance of coastal-swamp vegetable débris. Seeps of oil at localities indicating that the oil is contained in the Thomonde formation have been reported by several people but were not seen during the reconnaissance. There are no large seeps, residues, or mud volcanoes like those found in Trinidad, Venezuela, and Columbia, where rocks of the same age contain oil.

RESERVOIRS.

The Thomonde formation also contains rocks suitable to form reservoirs of oil. All parts of the formation include beds of sandstone and sandy siltstone that are more porous than the interbedded compact clayey siltstone. The conglomerates and coarse sandstones in the lower part of the Las Cahobas formation, however, are perhaps more suitable for reservoirs and they overlie the possible source of oil.

STRUCTURE AS AFFECTING ACCUMULATION OF OIL.

If oil were present in any of the beds underlying the plain it would collect in structural traps. The Thomonde, Chamouscadille, and Belladère anticlines are the most favorable structural features. If the crests of these folds extend across the plain they are probably arched into domes in the interior of the plain. Such domes would be the most favorable localities to test the possibility of obtaining oil in commercial quantities. In the interior of the southeastern part of the plain the beds that are possibly petroliferous are covered by the Las Cahobas formation and the base of the Thomonde formation is from 300 to 500 meters below the surface, the depth depending principally on the structure. Pools will hardly be found on any of the plunging anticlines inside the rim formed by the base



A. SOUTHWARD-DIPPING BEDS ON THE NORTHEAST SIDE OF THE
CENTRAL PLAIN NEAR THOMASSIQUE.



B. MAIN ENTRANCE TO THE CITADELLE OF CHRISTOPHE.
The citadelle is constructed of roughly shaped blocks of limestone and of bricks.

of the Las Cahobas formation, for the possibly petroliferous beds near their outcrop would lose the oil through flushing by artesian circulation. Although the entire Central Plain syncline plunges southeastward, it is not likely that the deeper beds in the interior of the plain have been flushed by ground water, because impervious beds crop out around the edge of the plain and its southeastward prolongation, the San Juan Valley, and because the floor of the syncline is far below sea level and apparently has never been above sea level since the beds were laid down.

RELATIONS TO FIELDS NEAR BY.

The only oil wells on the island of Haiti are those near Azua, in the Dominican Republic, where seeps have been known for a long time. The so-called Azua field has been described by Condit and Ross,¹ and the following summary is drawn from their account. Six wells have been drilled, and all except one are within a few hundred meters of the principal seep. According to reports, oil was found in all the wells at a depth of less than 290 meters. The production of the wells is not definitely known. All the wells were destroyed by salt water, which entered at a greater depth and was not controlled. The oil, a heavy, viscous oil of 19° to 21° Baumé, apparently contained no gasoline.

The possibilities of the Azua field have not been adequately tested. The rocks near the seeps are crumpled and faulted, and no attempt has been made to reach the petroliferous beds at a favorable locality farther from the outcrop. The oil obtained is probably not typical, as near the outcrop it may be modified by fractionation or by chemical reactions with downward-circulating ground water.

The rocks that crop out at the seeps in the Azua field are apparently equivalent to the lower part of the Artibonite group of the Central Plain, but the two areas of Miocene rocks are separated by a northeastward extension of the Sierra de Neiba.

CONCLUSIONS AS TO POSSIBILITY OF FINDING OIL.

The lithology and structure of the Miocene rocks of the Central Plain warrant a thorough search for oil. The interior of the southeastern part of the plain should be examined for domes along the crests of the Thomonde, Chamouscadille, and Belladère anticlines. The base of the Las Cahobas formation and the upper and middle parts of the Thomonde formation, which contain the most promising reservoirs for oil, would be within reach of the drill on such domes. Test wells should reach the upper Oligocene limestone, if oil is not found in higher beds, in order to test all the Miocene rocks. The region near Thomassique, where there is

¹ In Vaughan, T. W., Cooke, C. W., Condit, D. D., Ross, C. P., Woodring, W. P., and Calkins, F. C., *A geological reconnaissance of the Dominican Republic: Dominican Rep. Geol. Survey Mem., vol. 1, pp. 223-225, 1921.*

a structural terrace, should be tested if it is proved that the underlying rocks are petroliferous elsewhere.

The northwestern part of the plain is not so promising as the southeastern part. The lower part of the Thomonde formation is exposed on the Fond Bleu dome, and the thicker coarse detrital rocks of the same age on the plunging anticline between Maïssade and Pignon are probably entirely delta and flood-plain deposits.

POSSIBLE OIL IN OTHER REGIONS.

The Artibonite Valley resembles the Central Plain in many features, as structurally it is a northwestward-plunging syncline, modified by secondary anticlinal and synclinal folds. It also is floored with the Miocene rocks of the Artibonite group. Figures 12 (p. 207) and 13 (p. 208) show that a secondary anticline flanks the major synclinal trough on both sides of the valley. Except in the upper part of the valley the Miocene rocks consist principally of marl and limestone, which do not contain the rich fauna of deposits of the same age in the Central Plain. The Miocene rocks of the Artibonite Valley are therefore not so promising, either as a possible source of oil or as reservoirs.

Miocene rocks probably floor the Cul-de-Sac Plain under the cover of alluvium, but they are so completely concealed that their structure is indeterminable from surface observations. Their lithology, as observed at their outcrop along the borders of the plain, does not warrant any exploration with the drill.

Reports of asphalt near Étang de Miragoâne have been repeated in several accounts of the mineral resources of the Republic. Although no attempt was made during this reconnaissance to find the deposits, the geology of the region indicates that the reports are not authentic.

ROAD MATERIAL.

PRESENT STATE OF ROAD BUILDING.

As compared with the area of the Republic, the length of improved roads already built is very small, and most of them are not suited for heavy traffic. Roads that will bear heavy traffic are needed in the plains to facilitate agricultural development, and trunk lines connecting the larger cities and towns are desirable.

Although an unlimited amount of good material for road making is available, much of it is inconveniently situated, and a great deal of easily accessible but inferior material is therefore used.

Along the coast much of the soft coralliferous limestone of Quaternary age is used. It binds well but is too soft except for light traffic. Much gravel from stream beds and older gravel beds is used, especially in the Cul-de-Sac Plain. If properly graded and carefully laid it is reasonably satisfactory, although it also is rather soft. The impure