to the coast from the Montagnes de Terre-Neuve. Between Pointe Coridon and Pointe la Pierre the shore consists of a gradually narrowing strip of detritus derived from the steep mountain slopes, fringed by sandy beaches.

SUBLITTORAL FEATURES.

The relation between the width of the shallow offshore platform and the presence or absence of emerged coastal terrace is remarkably uniform along the coast of the Northwest Peninsula. From the mouth of Les Trois Rivières westward around the end of the peninsula and southeastward to Port-à-Piment, the platform, as limited by the 20-fathom line, is very narrow, and its outline closely coincides with the outline of the shore line. This platform, on which reef corals are growing, resembles the numerous emerged terraces. Southeast of Port-à-Piment, where the emerged terraces end, the outer edge of the platform diverges from the shore line, and off Pointe la Pierre the platform attains a maximum width of 10.9 kilo-

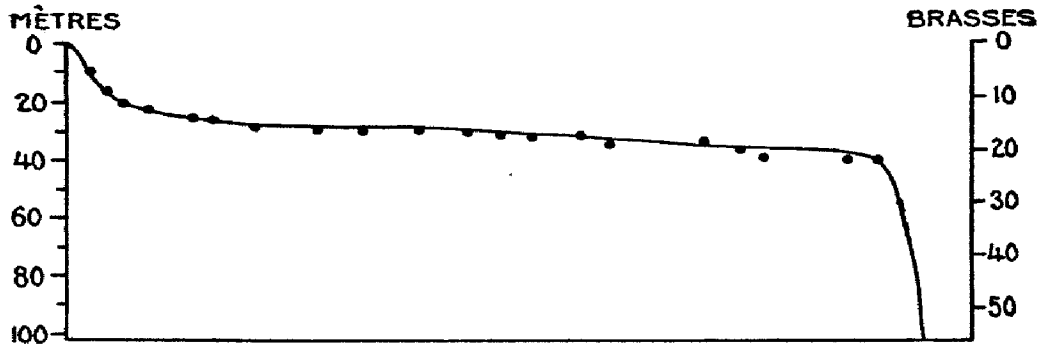

FIGURE 24.—Subaqueous profile off Pointe La Pierre near Gonaïves.
Horizontal scale 1 : 60,000. Vertical scale exaggerated 20 times.

meters. (See Fig. 24.) The conclusion seems warranted that the greater width of the platform is due to the longer interval of time during which it has been subjected to wave erosion. Figure 24 shows that along this part of the coast the maximum depth of effective wave erosion is 20 fathoms (36.5 meters).

The deep indentations in the offshore platform at Môle St.-Nicolas and Baie de Henne indicate that the valleys that extend into the interior of the plateau at these two localities are structural depressions, probably synclines.

CENTRAL PLAIN.

NAME AND EXTENT.

The name Plaine de Goave, or Guaba, was applied by Moreau de St. Méry and other geographers to the extensive plain between the Massif du Nord and the Montagnes Noires. As that name no longer has any local significance, the name Central Plain, first used by Jones,[1] is here used.

[1] Jones, W. F., A geological reconnaissance in Haiti: Jour. Geology, vol. 26, p. 730, 1918.

The Central Plain is the largest interior plain in the Republic. It extends from the Dominican border northwestward to St.-Michel de l'Atalaye like a wedge between the Massif du Nord and the Montagnes Noires. The prolongation of the plain in the Dominican Republic is called the San Juan Valley. From St.-Michel de l'Atalaye to the Dominican border the length of the plain is about 75 kilometers. The northwestern part is 22 kilometers wide, but in the central part the bordering ranges approach each other and the width of the plain is only 16 kilometers. Southeast of this narrow part the width of the plain increases abruptly to 40 kilometers. Toward the Dominican frontier the mountains bordering the plain converge slightly, and along the frontier between Belladère and Bánica the width of the plain is about 30 kilometers.

SURFACE FEATURES.

Northwestern Part.

The northwestern part of the plain is a flat grassy savanna, which slopes southeastward to a point about 10 kilometers northwest of Maïssade. The altitude above sea level at St.-Michel de l'Atalaye is about 425 meters and that at St.-Raphaël about 350 meters. Long reentrants of the savanna extend up main streams at St.-Michel de l'Atalaye, St.-Raphaël, and Pignon. The floor of the savanna consists of flood-plain gravel and silt deposited during a period when the streams were sluggish and meandered over the plain. The extensions of the savannas up the large valleys indicate that the main streams at that time occupied positions approximately the same as at present. These streams have recently entrenched themselves in the flood-plain deposits, probably because their gradient was increased by a change in the course of Rivière Artibonite below Las Cahobas (see p. 382). Rivière Bouyaha at the place where it is crossed by the trail from Maïssade to Pignon is entrenched 25 meters below the level of the plain, and Rivière Gouape, a tributary, is entrenched 15 meters. The smaller streams have scarcely begun to dissect the savanna.

The flood-plain deposits conceal the folded Miocene rocks, which control the surface features in the southeastern part of the plain. West of Pignon and south of St.-Raphaël some low ridges rise to a maximum height of 30 meters above the savanna. These ridges are probably composed of limestone similar to that in the mountains bordering the plain.

North of Maïssade an intricately dissected pine-covered ridge extends from the southeast into the savanna. Along the trail from Maïssade to Pignon the ridge is about 6 kilometers wide and its crest stands about 430 meters above sea level. It narrows toward the northwest and finally disappears beneath the flood-plain deposits of the savanna. The ridge is composed of conglomerate and sandstone.

West and southwest of Maïssade the plain is much more dissected, but flat-topped buttes with accordant summits at an altitude of about 345 meters above sea level indicate that the savanna formerly extended farther southward.

A much greater variety of surface features characterizes the region southwest of Maïssade, where folded Miocene rocks are exposed. An escarpment composed of the calcareous sediments in the upper part of the Madame Joie formation parallels the mountain front, facing outward from the plain. In the vicinity of Rivière Blanche the conglomerates in the Thomonde formation form a second escarpment facing in the same direction, farther from the mountains. This ridge ends abruptly along a fault on the southeast.

An elliptical depression eroded in the finer sediments of the lower part of the Thomonde formation occupies the crest of the Fond Bleu Dome.[1] Encircling it is an inward-facing escarpment formed by the overlying conglomerate. Southwest of the dome these conglomerates form a synclinal ridge with an outward-facing escarpment on the flank near the mountains similar to that in the vicinity of Rivière Blanche. A wide depression formed in the lower Thomonde beds intervenes between this escarpment and the mountain.

Southeastern Part.

Between Hinche and Las Cahobas the western margin of the plain is more rugged. Northeast of Thomonde a spur from the mountains projects southeastward into the plain along the axis of the Thomonde anticline. Several crescentic troughs and escarpments parallel the mountain spur. The largest trough, in which the town of Thomonde stands, coincides with the outcrop of the fine-grained sediments of the Thomonde formation. Near Thomonde the floor of the trough is a savanna deeply entrenched by Rivière Thomonde and its tributaries. The prominent escarpment, or "rim rock," which overlooks this trough is composed of conglomerates and sandstones in the lower part of the Las Cahobas formation. The outlet of Rivière Thomonde is the only gap in this escarpment. Successive dip slopes extend out into the plain from the crest of the escarpment.

The same surface features are duplicated on a reduced scale along the Chamouscadille anticline, south of the Thomonde anticline. Features that are similar but even more reduced appear along the Ayaye anticline south of the Chamouscadille anticline.

Along the foot of the mountains at the southern margin of the plain is a trough coinciding with the outcrop of the Thomonde formation. The town of Las Cahobas stands near the northern edge of this trough on a gravel-covered terrace at an altitude of about 215 meters above sea level.

[1] The Fond Bleu Dome and other structural features are described on pages 488-492.

A high escarpment consisting of conglomerate and limestone at the base of the Las Cahobas formation overlooks this trough. The ruins of old Fort Anglais, north of Las Cahobas, are on the highest part of the escarpment, where the crest is 145 meters above the town. Rivière de Las Cahobas flows northward through a wide alluvium-filled gap in the escarpment. This gap is shown in Plate XIV, *B*, page 168, a view westward from a place about a kilometer northeast of Las Cahobas. The main trail leading northeastward from Las Cahobas toward Thomonde and Belladère follows a narrower and higher gap. Dip slopes extend from the escarpment toward the interior of the plain.

The trough and the accompanying escarpment facing it extend eastward along the southern margin of the plain to the vicinity of Belladère, where they bulge northwestward along the axis of the Belladère anticline, forming a spur much like that at Thomonde. Belladère stands in the trough along the axis of this spur at an altitude of about 360 meters above sea level.

In the interior of the plain the most conspicuous surface features are remnants of a high-level plain and several terraces at lower altitudes. Between Hinche and Thomonde the high-level plain remnants consist of flood-plain deposits and lie at an altitude of about 300 meters above sea level. It is inferred that this plain is the southeastward continuation of the savanna that forms the northwestern extremity of the plain, remnants of which can be traced between Maïssade and Hinche, because if the surface of the isolated remnants were restored it would agree with the slope of the savanna. Entrenching of the streams is shown by terraces, four of which were seen between Hinche and Thomonde at altitudes of about 290, 265, 255, and 240 meters above sea level. The streams are entrenched 10 or 15 meters below the lowest terrace. The older terraces extend across the interstream areas or encircle small isolated patches of the high-level plain. Plate XXIX, *B*, shows three terraces as they appear looking southeastward from a place about 3 kilometers south of Hinche.

Discontinuous terraces extend across the interior of the plain along the trail from Thomonde to Thomassique. Rivière Guayamouc is entrenched 35 meters below a terrace that stands about 235 meters above sea level. Northeast of the river there are higher terraces, at altitudes of about 260 and 300 meters, but the highest terrace may correspond to the high-level plain.

It is inferred that Savane Chamouscadille, which is about 8 kilometers southeast of Thomonde on the trail to Las Cahobas, is an isolated part of the high-level plain. It is covered with flood-plain deposits at an altitude of about 285 meters above sea level. South of this savanna the trail passes near the boundary between the interior of the plain, where terraces are the most prominent surface features, and the western margin of the plain, where tilted ridges composed of Miocene rocks are the most conspicuous features. North of the crossing of Rivière Artibonite there

A. ACCORDANT CRESTS OF STRIKE RIDGES FORMED BY CONGLOMERATES OF THE LAS CAHOBAS FORMATION ON THE SOUTH SIDE OF THE CENTRAL PLAIN.

On the divides many of the ridges have a cap of stream gravels.

B. STREAM TERRACES IN THE CENTRAL PLAIN, AS SEEN LOOKING SOUTHEASTWARD ALONG THE TRAIL FROM HINCHE TO THOMONDE.

are terraces at altitudes of about 265, 235, and 190 meters above sea level. The surface of the alluvium in the present stream valley is 170 meters above sea level. On the south side of the river, as on the north side, the 190 meter terrace adjoins the alluvium; the widest terrace is 210 meters above sea level, and the highest is 225 meters.

Along the trail from Las Cahobas to Belladère the terrace gravels have been stripped off by erosion, except in isolated patches, and the underlying tilted Miocene rocks are exposed. The more resistant beds form low outward-facing escarpments. The accordant height of the summits of these escarpments (see Plate XXIX, *A*) indicates the southward continuation of the high-level plain. On this trail small terrace remnants were seen at altitudes of about 290, 320, and 350 meters above sea level.

The northeast edge of the plain is not so rugged as the west and south edges because the structure is more simple and the lithology of the Miocene rocks is more uniform. The most conspicuous surface features are dip slopes and outward-facing escarpments. Toward the foot of the mountains the dip slopes become steeper and the accompanying escarpments higher. Plate XXXVII, *A*, page 492, shows the dip slopes and escarpments near Thomassique. Toward the interior of the plain the dip slopes disappear beneath the cover of terrace deposits.

Drainage.

The Central Plain lies wholly within the drainage basin of Rivière Artibonite, which enters the plain at the Dominican border near Bánica and flows southwestward. Streams emerging from the mountains around the edge of the plain converge to form the southeastward-flowing Rivière Guayamouc, which joins the Artibonite as its largest tributary, in the south-central part of the plain.

In the northern two-thirds of the plain the drainage system is controlled by the structure, but in the southern third most of it is unrelated to the structure. Instead of continuing southeastward along the plunging trough of the syncline and thus finding access to the sea along the present course of Rio Yaque del Sur, the combined Guayamouc and Artibonite turn southwestward and cut through the high mountain wall of the Montagnes Noires northwest of Las Cahobas. In the absence of adequate maps it is impossible to trace precisely the history of this anomalous drainage. All the evidence available indicates that the plain drained into the San Juan Valley during the time when the high-level flood-plain deposits were laid down. The accordant erosion remnants of a high-level plain that slopes gently southeastward support this interpretation. At that time lateral streams in the southern part of the plain flowed in toward a main central stream, forming a drainage system like that now seen in the northern part of the plain. The flood-plain deposits are apparently of Pliocene age, and this drainage system probably persisted during early Quaternary time.

The entire drainage of the plain, apparently, was first diverted into the present course of Rivière Las Cahobas across the escarpment along the south margin of the plain and through the conspicuous gap in the Montagnes Noires southwest of Las Cahobas, as has been suggested by Tippenhauer,[1] and outlined by Jones.[2] The gap in the escarpment northwest of Las Cahobas seems much wider than it would be if cut by the stream that now occupies it. The gap in the Montagnes Noires southwest of Las Cahobas is all out of proportion to the present small streams that flow northeastward and southwestward from the divide in the gap, which has an altitude of about 245 meters above sea level. The cause of the diversion is not known. The high-level gravels at Las Cahobas and in the valley of Rivière Fer-à-Cheval south of the Montagnes Noires are, according to available information, about 30 meters lower than the gap. If the former surface of the plain were as high as the gap these gravels were deposited during a later stage of the drainage. Additional evidence concerning the outlet of the Central Plain drainage through the Las Cahobas gap, based on the features of the valley of Rivière Fer-à-Cheval, is considered on page 388.

The present gorge of the Artibonite is cut wholly in limestone and its course was probably determined by a former lateral stream in the north slope of the mountains that had an extensive underground drainage. After the gap across the Montagnes Noires at Las Cahobas was deepened down to the basement of volcanic rocks now exposed the deepening proceeded less rapidly, whereas the development of the underground drainage of the lateral streams was accelerated. The final diversion may have been due to the capture of this headward underground drainage by a southwestward-flowing tributary of the Artibonite on the south slope of the mountains. At the time of the diversion the surface of the plain probably coincided with one of the higher terraces along Rivière Artibonite above the mouth of Rivière de Las Cahobas. Between the present gorge and the mouth of Rivière de Las Cahobas the valley of the Artibonite is very narrow, presenting a contrast to the wide terraced valley above.

MONTAGNES NOIRES.

Name and Extent.

The name Montagnes Noires is here used for the mountains between the Central Plain and the Artibonite Valley and their prolongation eastward to the Dominican border. The entire mountain complex is named from the Montagnes Noires, the mountains immediately northwest of the gorge of Rivière Artibonite. The higher mountains farther northwest are generally called the Chaîne des Cahos. The range between the Central Plain and the valley of Rivière Fer-à-Cheval is unnamed.

[1] Tippenhauer, L. Gentil, Neuer Beitrag zur Topographie, Bevölkerungskunde, und Geologie Haïtis: Petermanns Mitt., Band 55, p. 53, 1909.

[2] Jones, William F., A geological reconnaissance in Haiti: Jour. Geology, vol. 26, pp. 748-749, 1918.

Toward the northwest the Montagnes Noires merge into the Massif du Nord, and toward the southeast they are continuous with the northern part of the Sierra de Neiba of the Dominican Republic. The northwestern boundary of the Montagnes Noires is drawn somewhat arbitrarily along the valley of Rivière d'Ennery and southeastward along the pass traversed by the road from Ennery to St.-Michel de l'Atalaye.

Between the valley of Rivière d'Ennery and the Dominican border the length of the Montagnes Noires is about 120 kilometers and their average width is 15 kilometers, but toward the southeast their width is reduced to 6 kilometers or even less.

GENERAL FEATURES.

The northwestern part of the Montagnes Noires comprises several mountain ranges, but the southeastern part is a single range. The trend of the ranges parallels the structural trend. The crest of the southeastern part of the range coincides with the crest of a simple anticline that trends about N. 70° W. This trend extends from the Dominican border westward to the conspicuous gap followed by the road from Mirebalais to Las Cahobas. Immediately northwest of this gap there is a single anticlinal range, but the trend changes to N. 50° W. Farther northwest the Montagnes Noires comprise several ranges, the crest of which generally coincides with the crest of a complex anticline. The conspicuous change in trend coincides with the change in trend of the upper part of the Artibonite Valley and in the mountain system included in the Montagnes du Trou d'Eau and the Chaîne des Mateux. A separate name might be justified for the range southeast of the gorge of Rivière Artibonite, as it strikes into the Artibonite Valley and is separated from the main part of the mountains by a syncline.

Limestones are the surface rocks over large areas in the Montagnes Noires. Older rocks are exposed in the deep valleys and possibly on the crests of the interior ranges.

SURFACE FEATURES.

Northwestern Part.

The northwestern part of the Montagnes Noires was crossed during the reconnaissance only along the trail between St.-Michel de l'Atalaye and Dessalines. Along this trail the mountains include several rugged ranges. The crest of the mountains is crossed at an altitude of 510 meters above sea level, but on both sides of the trail peaks rise to an estimated altitude of 1,200 meters above sea level. Morne Chapelet, a conspicuous peak near Ennery, has an estimated altitude of 1,400 meters above sea level. These mountains are very rugged. Stairlike cliffs rise for hundreds of meters on some of the slopes. Southwest of St.-Michel de l'Atalaye a low range composed of limestone faces the Central Plain. West of this

range Morne Salée rises to an estimated altitude of 800 meters above sea level. In this region the ridges are composed of limestone and are very rugged. The valleys have been cut down to the underlying volcanic rocks, and some of them have been enlarged into rolling interior lowlands. (See Pl. VI, *A*, p. 64.) Near Paul alluvial savannas are common in these lowlands, which have an altitude of about 400 meters above sea level, slightly higher than that of the Central Plain, into which they drain. Some of the valleys near Dessalines are like those near Paul, but they are narrower and have been cut down to an altitude of 100 meters above sea level. The western boundary of this part of the Montagnes Noires is a straight scarp that extends for many kilometers from the eastern side of the valley of Rivière la Quinte southeastward toward Dessalines and rises abruptly 300 to 600 meters above the Gonaïves Plain. (See Pl. XXV, *B*, p. 334.) This abrupt scarp apparently is a fault scarp, along which the western range of the mountains is tilted in a monoclinal block sloping northwestward. This type of structure, which has determined the surface features, extends farther west, as Morne Grammont, an isolated outlier of the Montagnes Noires rising above the Gonaïves Plain southeast of Gonaïves, apparently is a similar monoclinal block. Other hills near the boundary of the Montagnes Noires southeast of Morne Grammont are almost completely buried in alluvium.

Southeastern Part.

The top of the range southeast of the Las Cahobas gap is a rolling plateau, about 4 kilometers wide, in which large areas are covered with residual red clay. The central part of the range consists of limestone, and the slopes from the plateau are much steeper but less intricately dissected than those in the foothills, which are composed of younger detrital rocks. The range is bounded on the south by the narrow valley of Rivière Fer-à-Cheval, a prolongation of the Artibonite Valley. Along the trail from Belladère to Savanette the south slope of the range is much more precipitous than the north slope, descending from an altitude of 1,250 meters above sea level at the crest of the range to 535 meters above sea level at Savanette, only about 3 kilometers to the south.

Drainage.

The gorge of Rivière Artibonite, which cuts directly across the Montagnes Noires, and the abandoned gorge at Las Cahobas are the most conspicuous drainage features. The probable history of Rivière Artibonite is discussed on pages 381-382. In the northwestern part of the Montagnes Noires the drainage is almost completely controlled by the structure. Most of the streams flow either northwestward or southeastward, parallel to the strike of the rocks, and finally break across the outer ranges through deep, narrow gorges into the Artibonite Plain or the Central Plain.