

and the coast of the Republic of Haiti. A very narrow sublittoral platform extends westward along the coast from the Dominican border. Between Fort-Liberté Bay and Caracol Bay the platform widens, as its outer edge maintains a northwesterly direction, diverging somewhat from the shore line opposite the shallow inlet of Caracol Bay. The significance of the narrow platform off Fort Liberté is not known. In other parts of the Republic shore lines of submergence have wider sublittoral platforms or show traces of a submerged terrace scarp.

### MASSIF DU NORD.

#### NAME AND EXTENT.

The name Massif du Nord is here used for the northern mountain system of the Republic. It comprises a complex group of mountains and mountain ranges that extend from the Dominican border westward to the vicinity of Gros-Morne. The Massif du Nord is the northwestward prolongation of the Cordillera Central of the Dominican Republic. In the Republic of Haiti the belt of mountains is narrower, and as it occupies the northern part of the Republic a name similar to that given it in the Dominican Republic would be inappropriate. Many of the peaks and short ranges in the Massif du Nord have separate names, but no names are known for the major ranges.

The eastern half of the massif is bounded on the north by the North Plain and on the south by the Central Plain. The western half is bounded on the north by the sea and on the south by the Montagnes Noires, from which it is imperfectly separated by a gap that is traversed by the road from Gonaïves to St.-Michel de l'Atalaye. The deep trough of the valleys of Les Trois Rivières and Rivière la Quinte separates the massif from similar mountains in the eastern part of the Northwest Peninsula. The total length of the massif is about 120 kilometers, and its width is 25 to 40 kilometers.

#### GENERAL FEATURES.

The Massif du Nord constitutes one of the largest mountainous regions in the Republic. Some peaks in its western part attain estimated altitudes of 1,200 to 1,500 meters above sea level. In its central and eastern parts the altitudes range from 600 to 1,000 meters above sea level. The valleys are deep, and the crests of the mountains rise 300 to 1,000 meters above the valley floors. The relief is greater in the western and central parts than in the eastern part.

The mountains comprise a mass of peaks, short ridges, and longer ranges, the arrangement of which appears systematic only when considered with regard to the structure and the distribution of the surface rocks. As a whole, the massif is a complex northwestward-trending anticline. Many of the minor surface features have a corresponding northwestward trend.

All the massif east of the valley of Grande Rivière du Nord except a narrow band along the border of the Central Plain is composed of metamorphic volcanic rocks, metamorphic detrital rocks, and quartz diorite. The same rocks continue westward beyond the valley of Grande Rivière du Nord, but in the central part of the massif and along the southern border of the western part they are concealed by younger limestone. The metamorphic detrital rocks consist of rather soft argillites that yield readily to erosion and have had a marked effect on the development of the surface features.

#### LAND FEATURES.

##### EASTERN PART.

The eastern part of the Massif du Nord embraces the region between the valley of Grande Rivière du Nord and the Dominican border. This region has three different types of mountain features.

The northern part of this region from the Dominican border westward beyond Vallière is a mountainous highland. The general surface of the highland is undulating and has an altitude of 600 to 700 meters above sea level. Sharp-crested ridges that generally trend northwestward rise 200 to 300 meters above the general surface. The valleys are relatively shallow and have an altitude of about 500 meters above sea level. The village of Mont-Organisé is near the northern edge of the highland, at an altitude of 700 meters above sea level. Mont Ténèbres, which is west of Mont-Organisé, is the highest peak along the northern edge of the highland. Its crest rises perhaps 200 meters above the level of the highland at Mont-Organisé and from a distance appears rounded. Along the trail from Mont-Organisé to Ouanaminthe there is a difference in altitude of 400 meters between the outer edge of the mountains and the rock platform at their base. The slope is so steep that one viewing it from the plain can hardly believe that a trail ascends it. The uniform surface features of this mountainous highland are the result of the deep erosion of a batholith of quartz diorite.

The region west and south of the mountainous highland is occupied by a complex group of intricately dissected ridges that have a general northwestward trend. Probably the most striking difference between this region and the mountainous highland is the more intricate dissection and correspondingly greater relief. At any one locality the ridges have approximately equal heights. Their crests and the crests of the spurs are rounded. The ridges are separated by deep V-shaped valleys, and their flanks are deeply furrowed by ravines that have an intricate dendritic pattern. The trail from Cerca-la-Source northward to Lamielle crosses three ridges that stand, respectively, 605, 765, and 775 meters above sea level. From the crest of the third ridge the trail descends abruptly to the depression at Lamielle. This depression has the same intricate drainage pattern and

rounded divides that characterize the flanks of the ridges. The surface rocks in this entire region are metamorphic volcanic and detrital rocks.

The southernmost ridge in this part of the massif adjoining the Central Plain is a distinct feature. It is composed of beds of limestone that dip southwestward, toward the plain. This ridge is continuous from Pignon southeastward to the Dominican border. Pic de Pignon, a very conspicuous landmark in the northern part of the plain, is a conical peak that is isolated from this ridge by the gap of Rivière Gouape. From Rivière Gouape southeastward to the pass traversed by the trail from Thomassique to Cerca-la-Source the ridge has a fairly even crest, which is slightly notched by the high pass where the trail from Hinche to Cerca-Carbajal crosses it at an altitude of 600 meters above sea level. The pass along the trail from Thomassique to Cerca-la-Source is wider and has an altitude of only 470 meters above sea level. Southeastward from this pass toward the Dominican border the crest of the ridge descends steeply. The contrast between the south and north slopes of this ridge is very striking. The south slope is a uniform and relatively gentle dip slope, but the north slope, which apparently is a fault scarp, is precipitous and is scarred by high cliffs. To one looking westward from Cerca-la-Source (see Plate XXV, A, p. 334), this scarp is very impressive, as it rises to an altitude of perhaps 500 meters above the valley of Rivière l'Océan. The hot springs at Los Pozos, described on pages 562-564, are at the base of this scarp southeast of Cerca-la-Source, where the slope is not so steep.

#### CENTRAL PART.

The central part of the massif, as arbitrarily delimited, extends from the valley of Grande Rivière du Nord and St.-Raphaël westward to Plaisance and Ennery. The most striking surface features of this region are due to the presence of limestone, which covers a larger area in this region than in any other part of the massif. The mountains in this region are not so high as those to the east and west. The road from Ennery to Plaisance crosses Mont Puilboreau, one of the highest ranges, at an altitude of 950 meters above sea level.

The eastern part of this region, near Grande-Rivière du Nord and Dondon, is occupied by intricately dissected mountains composed of metamorphic igneous and detrital rocks. These mountains are bordered entirely on the southwest and in part on the northeast by ranges composed of tilted beds of limestone. The mountains that consist principally of limestone are characterized by deep canyon-like ravines. Some of the mountain slopes—for example, that at St.-Raphaël and the upper part of the southwest slope of Mont Puilboreau—conform to the dip of the limestone. The opposite slope is generally a steep escarpment or even a sheer cliff. The cliffs on the northeast slope of Mont Puilboreau are several hundred meters high. There is a very prominent cliff just west of Dondon. High cliffs may also scar the slopes of gently tilted beds of limestone.

A high ridge called Bonnet-à-l'Évêque extends northward to the edge of the North Plain west of Milot. It is composed of porphyry and metamorphic detrital rocks capped by limestone. The limestone rises above the contact with the underlying rocks in almost sheer cliffs. Christophe's citadel stands on the crest of this ridge at an altitude of 865 meters above sea level. The crest of the ridge north of the citadel is very jagged. From the west wall of the citadel there is a sheer drop of probably 150 meters.

Caves and sink holes are minor features of the limestone mountains. The development of sink holes has not progressed far enough to dominate the surface features except in a few small areas.

#### WESTERN PART.

The western part of the massif includes all the mountains north of an east-west line drawn through Christophe's citadel and Plaisance. It contains the highest mountains in the massif. Between Acul Bay and Port-de-Paix the mountains reach the sea, but at the mouth of Rivière de Port-Margot they are bordered by a narrow coastal plain.

Between Limbé and Plaisance and between Port-Margot and Pilate the mountains are intricately dissected. They are composed of metamorphic volcanic rocks and have essentially the same features as the mountains in the central region of the eastern part of the massif. The road from Limbé to Plaisance crosses their crest at an altitude of 520 meters above sea level, and the trail between Port-Margot and Pilate reaches an altitude of 540 meters above sea level. Mont Maleuvre, the highest peak south of Port-Margot, has an estimated altitude of 1,200 meters above sea level. The longitudinal profile of the mountains is serrate, but in transverse profile their crests are rounded. The ridges are separated by deep, narrow valleys and their flanks are intricately furrowed by ravines, all of which contain running water. The deep, wide valley of Les Trois Rivières borders these mountains on the south. South of the valley of Les Trois Rivières rises the steep, scarred slope of a limestone range, the northward prolongation of Mont Puilboreau. The south slope of this range is virtually continuous with the Montagnes Noires, as the two mountainous regions are separated only by the narrow gap of Rivière d'Ennery. These limestone mountains in the southern part of the massif end abruptly along the fault scarp on the east side of the valley of Rivière le Quinte. Morne Deux Mamelles is a conspicuous peak along this fault scarp. The isolated mass of Gros Morne, which stands near the western edge of the Massif du Nord, southeast of the town of Gros-Morne, towers to an altitude of perhaps 1,200 meters above sea level. It is apparently composed principally of volcanic rocks.

The range that parallels the coast between Port-Margot and Anse-à-Foleur is composed of limestone that dips steeply seaward. Northwest of Anse-à-Foleur this range is separated from the coast by a rolling lowland

underlain by younger detrital rocks. Several streams—for example, those at Le Borgne and Anse-à-Foleur—reach the sea through deep, narrow gaps in this range. At many localities the seaward or dip slope of the range is barely furrowed by ravines, in marked contrast to the intricately furrowed flanks of the higher interior mountains. A very conspicuous peak in the interior about 12 kilometers southeast of Port-de-Paix has an estimated altitude of 1,200 meters above sea level.

#### MORNE DU CAP.

The Morne du Cap is a rough, broken mountain that lies between Acul Bay and Cap-Haïtien Bay. It is an outlier and properly a part of the north flank of the Massif du Nord. Its crest, which trends approximately east and west, has an altitude of 600 to 800 meters above sea level, and one peak reaches an altitude of about 827 meters. Its length from east to west is about 12 kilometers, and its width is 7 or 8 kilometers.

The Morne du Cap is composed of a sheet of limestone overlying older metamorphic detrital and igneous rocks. The northward dip of the limestone accounts for the short, steep southern slope and the longer northern slope of the mountain. The southward-facing escarpment, scarred by cliffs, coincides with the cap of limestone. The height of this escarpment and that of the mountain diminishes from east to west. Below the escarpment are gentler slopes in igneous rocks, deeply trenched by ravines that are separated by rounded divides. This slope gradually merges into the low rounded hills that dot the North Plain southeast of Acul Bay, joining the Morne du Cap to the Massif du Nord. The hill on which Fort Belair stands, near Cap-Haïtien, is a good example of this kind of rounded hill.

Most of the longer northern slope of the Morne du Cap is composed of limestone, although many of the ravines are cut down into the older rocks. The limestone extends down to sea level at many localities. The slope is rugged, and small cliffs are common. There are no permanent streams, but the slope is strongly dissected except in certain areas where sink holes are conspicuous features. A semi-detached ridge, called Morne de la Vigie, which reaches an altitude of about 300 meters above sea level, extends northward from Cap-Haïtien. It consists principally of limestone, in which there are conspicuous sink holes, particularly west of Fort Picolet lighthouse, where the rock is a mere mass of fragments honey-combed by holes and caverns.

#### DRAINAGE.

The drainage pattern differs in different parts of the Massif du Nord. In the regions where volcanic rocks are exposed at the surface the pattern is dendritic, but in regions where limestone and metamorphic detrital rocks crop out the drainage is generally adjusted to the structure.

In the eastern part of the massif most of the streams originate at an apex near Vallière and radiate outward in almost all directions. Some of the streams—for example, Rivière Ténèbres—in a short distance take southeastward or northwestward courses, parallel to the trend of the mountains. The valley of Rivière l'Océan is in a band of argillites that yield readily to erosion. At present this stream has no flood plain but is entrenched 30 meters below the level of a barely dissected old flood plain at an altitude of 400 meters above sea level, on which stands Cerca-la-Source. In its upper course Grande Rivière du Nord parallels the strike of the rocks, but its lower course is transverse to the prevailing structural trend. The river has a very narrow but continuous flood plain.

In the central part of the massif several streams originate at an apex near Marmelade. Most of them flow northwestward or southwestward, parallel to the mountain ranges. Rivière Canot, Rivière Atalaye, Rivière Bouyaha, and Rivière Gouape break across these ranges to reach the Central Plain. Rivière Atalaye and Rivière Bouyaha cross the outermost range in deep, narrow gorges with sheer limestone walls. Rivière Samaná cascades down the dip slope of the limestone range into the Central Plain.

The largest valley in the massif is that of Les Trois Rivières, which is called Rivière de Plaisance at and above Plaisance. This valley, like that of Rivière l'Océan, owes its origin to relatively soft argillites which when once exposed are easily carved into wide valleys. The irregularities in the surface of the valley at Plaisance are due to the complex folding and the varying hardness of these rocks. Les Trois Rivières leaves the outcrop of these rocks at Pilate and flows westward in a wide gorge diagonally across the prevailing trends to Gros-Morne, where it emerges from the massif and turns abruptly northward.

#### SHORE FEATURES.

The Morne du Cap abruptly interrupts the low coast that characterizes the seaward margin of the North Plain. Cap-Haïtien is on a narrow alluvial shelf that skirts the base of the mountain. From the northern edge of the town northward and westward to Acul Bay the mountain reaches the sea. The promontories are truncated by sea cliffs having a maximum height of 100 meters and an average height of 25 to 30 meters. The stretches of steep and unapproachable coast are broken by small areas of alluvium at the heads of little coves.

West of the Morne du Cap the shore line is deeply indented by Acul Bay, a unilateral pouch-shaped harbor, probably a submerged valley. The Morne du Cap borders the northern half of the eastern shore of the bay, but the height of the sea cliffs on the promontories diminishes southward. The remainder of the shore of the bay is low and swampy and forms the western termination of the North Plain.

From Pointe Limbé northwestward to Le Borgne there is a series of small bays separated by rocky promontories. The heads of the bays are

filled with a narrow fringe of alluvium and the untterraced promontories are truncated by sea cliffs.

From Le Borgne to the promontory on the east side of Anse-à-Foleur the shore is the truncated flank of a limestone mountain range and is relatively straight. Sea cliffs here attain a height of 30 to 50 meters. This kind of inaccessible coast is known as côtes-de-fer. The trail from Cap-Haïtien to Port-de-Paix winds up and down the deep, narrow ravines back from the coast. Anse à Foleur and the similar but smaller bay between Pointe Foleur and Cap Rouge lie between truncated untterraced headlands. The heads of both of these coves are filled with alluvium.

Between Cap Rouge and Port-de-Paix the shore gradually assumes the characteristic features of the shore line of the Northwest Peninsula. The low beach along this part of the coast is interrupted by low promontories, which are formed of Quaternary marine deposits. The low truncated promontories on both sides of the small embayment of Port-de-Paix

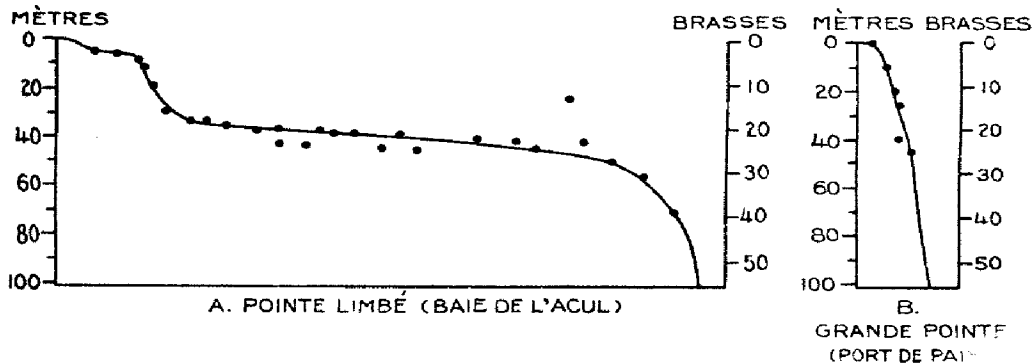


FIGURE 23.—Subaqueous profiles off the north coast.

Horizontal scale 1 : 70,000. Vertical scale exaggerated 20 times.

harbor are composed of reef rock overlying poorly consolidated gravel and sand. On the west side of the bay the upper surface of the reef rock is about 12 meters above sea level. Between Port-de-Paix and the wide alluvial flat at the mouth of Les Trois Rivières there is a similar low promontory.

#### SUBLITTORAL FEATURES.

The outer edge of the sublittoral platform off the coast of the Massif du Nord, as limited by the 20-fathom line, has an almost uniform trend of N. 75° W., despite the irregularities of the shore line. Off Acul Bay the platform attains a maximum width of 15 kilometers, but it becomes progressively narrower northwestward. At Port-de-Paix it is indented parallel to the shore line and its maximum width is only 0.5 kilometer. As the depth of the channel in Acul Bay exceeds the depth of water on most of the platform this bay seems to be a submerged valley.

The littoral and sublittoral features of the coast of the North Plain and of the Massif du Nord westward to Le Borgne indicate that this part of the coast of the Republic has been recently submerged. Figure 23, A,

shows a subaqueous profile off Pointe Limbé, west of the entrance to Acul Bay, based on chart No. 5251 of the Hydrographic Office, U. S. Navy. The plotted points represent depths recorded along and near the line of profile, which is drawn perpendicular to the contours. The narrow, shallow bank where the depth is less than 5 fathoms (9.1 meters) apparently is a reef, but the lower part of the abrupt slope between 5 fathoms and 18 fathoms (32.9 meters) may be part of a submerged terrace scarp. The wide platform extending seaward from the foot of this scarp slopes from 18 fathoms to 30 fathoms (45.7 meters). This platform seems to be slightly submerged, as in other parts of the Republic wave-cut platforms have a maximum depth of 20 fathoms (36.5 meters). (See Fig. 24, p. 377.) On the east side of the entrance to Acul Bay the submerged platform is obscured by the reefs that are growing on it. Detailed charts are not available for other parts of the coast having shore features characteristic of submergence.

Westward from Cap Rouge the shore line is clearly a shore line of emergence, and the emergence is progressively greater toward the end of the Northwest Peninsula. Figure 23, *B*, a subaqueous profile off Grand Pointe on the east side of Port-de-Paix harbor (Chart No. 5250) is a typical profile of a recently emerged shore line. The significance of these two contrasted types of shore line is considered elsewhere.

## NORTHWEST PENINSULA.

### EXTENT AND GENERAL FEATURES.

The Northwest Peninsula is a mountainous region resembling in many features the Massif du Nord, from which it is severed by the deep trough here called the Trois Rivières Valley. The name as used here denotes the entire region west of this trough. The length of the peninsula from east to west is about 75 kilometers, and its average width is 35 kilometers.

Several mountain ranges constitute the axis of the peninsula. In the southeastern part of the peninsula the ranges trend about N. 50° W. and attain altitudes slightly more than 1,000 meters above sea level in the communes of Terre-Neuve and Gros-Morne. In the main body of the peninsula the ranges trend approximately east and west and attain altitudes less than 700 meters above sea level. These ranges stand about halfway between the north and the south coast and are bordered on the north and south by lowlands that are only 200 or 300 meters above sea level. The west end of the peninsula is a broad plateau with terraced seaward borders that has a maximum altitude of 450 meters above sea level.

The diversity of surface features is partly due to the diversity of surface rocks. Virtually all the mountain ranges contain a basement of igneous rocks covered by a great thickness of limestone. Soft marls and sandstones extend around the mountains and overlap the rocks that com-