

Peninsula, would make good roads. Large areas of basaltic and andesitic rocks crop out in the Massif du Nord from Grande-Rivière westward to Port-de-Paix and in the Terre-Neuve region. Small exposures of basaltic and andesitic rocks also occur near the road between Dessalines and Gonaïves. Metamorphosed basaltic rocks also are known at accessible locations on the North Plain near the head of Acul Bay and at the southern border of the plain east of Le Trou. Other basaltic rocks crop out at the foot of the mountains near Thomazeau and Maneville.

The coarsely crystalline intrusive igneous rocks, such as quartz diorite and granodiorite, occur mainly in the Massif du Nord, from Grande-Rivière eastward to the Dominican border. These rocks are less desirable as road material and probably need not be used to any great extent.

The hard Eocene and Oligocene limestones will make good roads where traffic is not too heavy, and because of their very wide distribution they probably will be used extensively. They occur in practically every mountain range in the Republic.

Gravel is found in the plains and valleys where roads are especially needed. It is the cheapest and most accessible road material available, for machinery would be required to quarry and crush the igneous rocks and limestone. An extensive program of highway construction is entirely unwarranted at present, and highways constructed of gravel would be satisfactory in the more thickly populated plains. The gravels are very irregular in texture and composition, and careful grading is necessary to assure good results. The best gravel, composed mainly of fragments of igneous rocks, is found in extensive areas only on the North Plain.

The soft coralliferous limestones of the coast and of the Miocene formations are better than dirt but are inferior to any of the other rocks for road material.

BUILDING STONE.

Many of the walls, aqueducts, and other structures built during and since the colonial period consist of rubble masonry, made of rough field stones laid in thick mortar. Bricks were used liberally wherever the stones did not fit well, as in arches and at corners. Limestone boulders generally were used because they were most common. Occasionally, especially at Port-au-Prince and Cap-Haïtien, large coral heads from the living reefs take the place of boulders. Many of the colonial structures of this type were well built, and parts of them are still intact.

At Port-au-Prince considerable chalk from the hardened upper crust of the Quaternary conglomerate is used in buildings and for foundations. It is very easily quarried but too soft to shape well. The rough, irregular lumps are laid in thick lime mortar. The life of this material appears to be short, and failures of structures in which it has been used are rather common.

Near the coast soft coralliferous limestones of Quaternary age have been quarried at a few places. The best quarry seen was about a kilometer north of Môle St.-Nicolas, near the road to Jean Rabel. The limestone is fairly hard, and the thickness of the beds is from 20 to 50 centimeters. Good dimension stone was obtained and used in the extensive fortifications around the harbor. The stone has lasted well, for the forts have not been repaired for more than a hundred years.

The only place observed where the older hard limestones have been used to any great extent is in the citadel at La Ferrière, which was constructed largely of Eocene limestone from the mountain on which it stands. The stone is roughly shaped and is laid as coursed rubble. Bricks were used freely, however, particularly in facing the openings (Pl. XXXVII, B). This structure has stood more than a century, and the main walls are in reasonably good condition, indicating that the stone is durable.

Some of the dense, uniformly colored Tertiary limestones take a high polish and would be suitable for use in interior decoration.

A good building stone must fill several requirements. In the first place it must be strong enough to resist crushing. With the possible exception of the chalk at Port-au-Prince, all the rocks of the Republic have a crushing strength much greater than is needed in ordinary structures.

The next desirable property is durability. The chalk mentioned above and the very soft, poorly consolidated beds in the coralliferous limestones are not very durable, but all the harder limestones of Eocene or Oligocene age and most of the igneous rocks would last well. Climatic conditions are favorable, as there is no frost. Moreover, there is little of the smoke and injurious gases, such as cause deterioration of building stones in manufacturing districts.

Color is important. The color of the stone in any building should be fairly uniform, but the shade is largely a matter of taste and of prevailing opinion. The coralliferous limestones weather to a monotonous drab or gray. The Eocene and Oligocene limestones would be whiter and probably more attractive. Some of the igneous rocks, particularly the quartz diorites, would be pleasing in appearance, although they are not highly colored. Care must be taken in selecting them to get material free from pyrite, which weathers and produces unsightly brown stains. The pink quartz diorite in the mountains south of Jean Rabel, which is probably the most attractively colored stone observed, unfortunately contains much pyrite. Some of the gray quartz diorites near Grande-Rivière du Nord also contain pyrite.

The cost of building stone depends principally on the difficulty of quarrying. The limestones are fairly soft, and their bedding facilitates quarrying. Most of the Eocene and Oligocene limestone is too thin-bedded to furnish good dimension stone, but thicker beds can be found by careful search. Igneous rocks generally can be worked easily only where joints

occur at convenient intervals to assist in breaking out the stone. The quartz diorites have such jointing at many places. The basalts, however, are at many places too minutely jointed to yield large blocks. Moreover, basalt is generally very tough and difficult to work.

Last of all, the location of quarries is determined largely by accessibility either to the locality where the stone is to be used or to transportation facilities. The Quaternary limestone of Môle St.-Nicolas is well located for transportation by water. Similar stone probably could be obtained near the railway on the terraces of coralliferous limestone on Cap-St.-Marc. The quartz diorites of the north could be obtained near the railway between Grande-Rivière du Nord and Bahun, although they are not so handsome there as farther east. At present there is little demand for stone of this kind.

ROCK FOR CONCRETE.

Rock for concrete should be reasonably hard and should consist of material so graded in size that the smaller pieces will fill the open spaces between the larger ones. A rough surface probably increases the binding power, and for this reason crushed stone has been preferred by many engineers to rounded gravel, some even prescribing that gravel, if used at all, should be crushed. Experience in the Republic of Haiti has shown that this is generally unnecessary and that the natural gravel makes excellent concrete. The gravel is composed mainly of pebbles of hard limestone or of igneous rock, either of which are satisfactory. Crushed stone from these same rocks would of course be equally satisfactory. However, machinery for crushing has not been available up to this time, and breaking by hand is so expensive that gravel has been used almost entirely.

LIME.

A great deal of lime is made in the Republic for domestic use. Most of it is used for mortar or for whitewash. All the pure limestones are burned to make lime, and occasionally coral heads from the living reefs are used. Small quantities of lime are made by mixing wood and stone and burning in heaps in the open air. For larger quantities crude kilns are made, preferably on chalky hillsides. A pit is dug like a well, and an entrance is made at the base by a tunnel if necessary. The fuel is placed below and the rock above. By neither method can the rock be burned completely and evenly, and the product is inferior to that of carefully operated commercial plants.

Much of the limestone of the Republic is remarkably pure, as is shown by the two analyses in the following table. Rock of this kind makes a quick setting high-calcium lime.