

THE VEGETATION OF BEATA AND ALTA VELA ISLANDS, HISPANIOLA

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With five plates

PERHAPS THE LEAST EXPLORED AREA of the Greater Antilles is the southern promontory of the Dominican Republic, the province of Barahona. Only one unimproved road extends across this low-lying, triangular-shaped, dry waste of Eocene and Pleistocene limestone and through the thorn shrub forests and brush lands. Only the collections of Nash and Taylor, Ekman, and Howard are available from this area, and these represent scattered locations and incomplete records of a promising flora rich in dry-land and desert endemics. Off the southern tip of this promontory are two small islands, Beata and Alta Vela, which are the basis for this study. Beata and Alta Vela, geologically related to the tip of Barahona peninsula, are intriguing small bits of land in the Antilles. Both are important in the role they have played in the history of the Caribbean. Beata was visited casually twice by botanists, and until the occasion of my trip there, Alta Vela was unrepresented in the botanical records of the Antilles.

I had seen these two islands several times from the sea, land, and air. My desire to visit them was accentuated by the fact that Erik Ekman, perhaps the most thorough of botanical collectors who have visited Hispaniola, had never been on these islands. During his extensive stay in Haiti and the Dominican Republic Ekman visited many of the islands adjacent to this larger land mass. He published comprehensive studies of the vegetation on Los Siete Hermanos, Tortue, Gonave, and Navassa, and found on each richness of endemics and significant information on the relationships of the floristic entities in Hispaniola. Beata and Alta Vela, lying as they do, should contribute additional information in the phytogeographic puzzles of the southern peninsula of Haiti and the Barahona coastal ranges.

Thus, in planning a visit to the Dominican Republic in 1950, I wrote in advance to the government of the Dominican Republic for permission to visit Beata and Alta Vela. This was necessary because Beata is a naval station of the armed forces of the Dominican Republic, which also maintain on Alta Vela a lighthouse. My request was referred to Mr. Manuel de Moya, then Secretary of Agriculture, who took prompt action to grant my request and to expedite my visit to these islands. Instructions were given

* The botanical observations and the collections which form the basis for this paper were made in 1950 when I had the opportunity of spending seven months in the Caribbean Islands. This extensive trip was made possible financially by grants from the Penrose Fund of the American Philosophical Society and the Milton Fund of Harvard University. I am particularly grateful for this support.

to the commander of the destroyer escort vessel "27 de Febrero" to call at the Port of Barahona and to supply transportation as I wished. It is difficult to express adequately my gratitude to Mr. Moya and to the commander and men of this vessel for their complete cooperation in making this botanical expedition possible.

We left Barahona on August 7th, making the run to Beata in a few hours. This in itself stands in contrast to the visit Alexander Wetmore made to Beata in 1929, when he rented a sailboat and spent twenty-four hours getting from Barahona to Beata and three days on the return voyage. The crew of the "27 de Febrero" supplied transportation from the anchorage in the northwest corner of the island several times daily to shore and back to the boat. A cot was supplied me when I chose to sleep on deck rather than in the officers' quarters in the shorter bunk which had been offered below deck. The meals were those of the officers' mess and were rich with the natural products of the country and the sea and beaches of and around Beata. Plantains, cassava, and other root crops were supplemented and augmented with a great variety of sea food from the Caribbean, turtle steaks from animals we netted or caught on the beaches, and goats which the crew shot in the thorn scrub of Beata. Each day the ship lifted anchor and took me to a different section of the Beata shore line to explore inward, and a one-day trip was made to Alta Vela before the week I had allotted was up and it was necessary to return to Barahona. I enjoyed the hospitality and courtesy of the Dominican Navy and the company of the crew on many trips into the difficult vegetation of these islands.

Beata Island was apparently first seen by Columbus on his second voyage. On his third voyage, in 1498, Columbus is reported to have arrived at his former anchorage under the little island of Beata on the twentieth of August.

The first complete description of Beata appears in a report of the U. S. Coast Survey in Senate Executive Document No. 38 of the Fortieth Congress, 1868. This report considers both Beata and Alta Vela and mentions that "Beata island, the larger of the two, lies four miles south by east from Beata point, the southernmost extension of Barahona peninsula." The island is described as "five miles long and two miles broad mostly covered with brushwood from 50-80 feet high. The southern part is the most elevated and the northern end terminates in a long low point. Off the west point there is no bottom to 136 fathoms of line three quarters of a mile distant. The east side is very deep and the north and northeast sides connect to Beata point by a shallow white bank with the greatest depth being three fathoms."

Various reports of the richness and the utilization of Beata Island appear in the older literature and descriptions of the island, entirely unsupported by any evidence found on the island today. Moreau de Saint-Méry in 1796 described the abundance and quality of the wood on Beata, which indicated the high fertility of the land. Additional comment was made on the increase in the size of the herds on the island. Moreau felt it possible to establish estates with flocks of sheep, as existed in former times. James

Playfair in his *Geography* (6: 625. 1814) states, "On Beata the soil is good and was once in a state of cultivation. Till the fall of Santo Domingo, it was the great resort of French privateers." As recently as 1918 Otto Schoenrich (*Santo Domingo, A Country with a Future*, pages 113-114) described Beata as follows: "The island is covered with dense forests in which wild cattle abound. During the sixteenth and seventeenth centuries the island was a convenient resort for the pirates that infested the Spanish main; at one time it is said to have contained fine plantations, but at the present it is only occasionally visited by Dominican or Haitian fishermen." These reports are hard to believe in the light of a present-day examination of the island.

Only two modern visits to the island have been made by botanists, to the best of my knowledge, although zoologists and anthropologists have been there more frequently. The Danish Oceanographical Expedition with the steamer *Dana* explored the warmer parts of the Caribbean Sea and the Gulf of Panama in 1921 and 1922. Strong trade winds forced this ship to seek shelter on the west side of Beata on Feb. 22, 1922, and apparently it was anchored in essentially the same spot that Columbus chose. One of the botanists aboard this ship was C. H. Ostenfeld, who took advantage of the two-day lay-over to collect marine algae and to make a short visit ashore. The specimens of flowering plants which he collected were described by Urban in the *Dansk Botanisk Arkiv* 4(7): 1-37. 1924. Ostenfeld reports that they landed at the northwest corner of the island. "No inhabited human dwellings were to be seen but a grassy area mostly covered with *Panicum* (*maximum?*) and scattered cotton plants shew that formerly culture had existed here." Ostenfeld indicated throughout his brief report that the island was a difficult place to travel on or to collect plants.

Between 1929 and 1934 the expeditions sponsored by Allison Armour on his yacht the *Utowana* made several stops at Beata Island. I have been unable to date these specifically and have been able to locate only four records of plants collected during these visits. Thomas Barbour in his privately printed book, "Allison Armour and the *Utowana*," refers to his visits to Beata aboard the *Utowana* in the spring of 1929 and again in April of 1934. In 1932 the *Utowana* apparently made another visit to Beata Island, for one of the plants collected by the botanists aboard, David Fairchild and P. H. Dorsett, proved to be new and was described as a new genus *Armouria* (= *Ulbrichia*) of the Malvaceae. Mr. Harold Loomis, director of the Plant Introduction Station of the U. S. Department of Agriculture at Coconut Grove, Florida, was also on this expedition and introduced seeds of this new genus for cultivation in Florida. David Rogers, in his revision of *Stegnosperma* of the Phytolaccaceae, cites two other collections from Beata Island by these men. No collectors' lists or field books have been located for this expedition, although a gap of twelve numbers occurs between the *Stegnosperma* and *Armouria* collections.*

* After this paper was prepared I had the opportunity of visiting Mrs. David Fairchild at Coconut Grove and Mr. Harold Loomis at the Plant Introduction Station, also in Coconut Grove, Florida. Mrs. Fairchild kindly made Dr. David Fairchild's

Herbert W. Krieger, in an article on the Culture Sequences in Haiti (Smithsonian Institution Publication 3134: 113-124. 1932) refers to Beata Island and publishes a photograph of the shell mounds of pure *Strombus gigas* on the island. I was unable to determine the source of this photograph or the nature of the expedition. Alexander Wetmore visited Beata for a time in the spring of 1931, as he reports in the Smithsonian Institution Publication 3134: 45-54. 1932. He and his party hired a sailboat and sailed for Barahona. Wetmore illustrated a small settlement called Ocrik on Beata Island and reported that his party stayed in one of the houses. The settlement at Ocrik was not in evidence during my visit in 1950. Wetmore's description of the vegetation indicated that it has changed little since Ostenfeld's visit, as he reports, "Thorny bushes, trees and vines growing from the scanty soil accumulated in crevices in the rock form a jungle so dense that it may be penetrated only along trails cut laboriously into the interior."

Thus I seem to be the first botanist to make a deliberate attempt to visit this island and to make comprehensive collections. I am not satisfied

field notes for this expedition available to me for study. She was also able to refer to photographs made on Beata Island, and her recollections of the Utowana's stay at Beata were most pleasant and helpful. Mr. Loomis, also, was able to refer to field books for information on his collections as a member of the party, and he had some excellent photographs of the area. From the field notes of Dr. Fairchild and Mr. Loomis I was able to prepare a numerical list of their collections on Beata, and Mr. E. C. Leonard of the U. S. National Herbarium has been most helpful in checking the herbarium for these specimens. He was not able to locate all of them, and in some cases in the following list field determinations are given. I am most indebted to Mrs. Fairchild, Mr. Loomis, and Mr. Leonard for their assistance.

The Utowana, with Fairchild, Dorsett and Loomis as botanists, stopped at Beata Island on January 17th and March 22nd, 1932. Only a single collection was made by Loomis on the latter date. He collected six numbers on the island on January 17th. Number 15 was identified in the field as *Coccothrinax ekmanii*. This is currently called *Haitiella ekmanii*. The specimen was not located in the National Herbarium. Numbers 16, 17, 18, 19 and 20 collected by Mr. Loomis were species of *Gossypium*. No material could be located at the National Herbarium. On March 22, 1932, Mr. Loomis collected a single number, 94, representing *Pseudophoenix saonae*. Mr. Loomis stated that Cook was in doubt regarding this identification at the time, but Mr. Leonard reports that a specimen so identified is in the National Herbarium.

The following collections by Fairchild and Dorsett were all made on Beata Island on January 17, 1932. Specimens present in the National Herbarium are indicated with an asterisk. All other names represent field identifications from Dr. Fairchild's field notebooks: 2603, *Guilandina ovalifolia*; 2604, *Opuntia moniliformis*; 2605, *Stegnosperma cubense**; 2606, *Stegnosperma cubense**. Number 2606 in Fairchild's field notebook is identified as *Zanthoxylum* sp. A specimen with the same number is cited by Rogers and is in the National Herbarium as *Stegnosperma cubense*. No. 2607, *Capparis flexuosa**; 2608, *Plumeria obtusa* var. *obtusata**; 2609, *Tribulus cistoides*; 2610, *Bromelia* sp.; 2611, *Exogonium eriospermum**; 2612, *Canavalia maritima**; 2613, *Maytenus reynosioides**; 2614, *Coccothrinax ekmanii*; 2615, *Rhynchosia minima**; 2616, *Indigofera suffruticosa**; 2617, *Ulbrichia beatensis**.

One addition can be made to the list of species from Beata Island given in this paper, on the basis of the Fairchild and Dorsett collections available in the National Herbarium. *Rhynchosia minima* (L.) DC. should be added to the Leguminosae.

that I have mastered the flora, however, and wish to pay a return visit at a different season.

Beata today appears from the sea to be a low flat island (FIG. 1). It is a large block of limestone which apparently has been tilted by coastal adjustments. The island is approximately five miles long and three miles broad, according to the skipper of the "27 de Febrero." It is shaped like a wedge of pie, broadest at the northern end and slightly rounded at the south. The north end (FIG. 3) is a sandy plain, at sea level, interrupted by shallow bays now filled with marine succulents and mangroves. The eastern side, likewise, is mostly level with the sea. The greatest elevation is approximately three hundred feet, at the southwest corner. The entire western side of the island shows a series of wave-cut benches with an escarpment of fifty to two hundred feet running from the coast at the north to a point well inland at the southern end of the island (FIG. 2). The surface of this major block is essentially flat, tilting slightly to the northeast. It appears, therefore, that this block of limestone has been tilted by sinkings on the northern and eastern edges. The first crustal adjustment was the most severe, but evidence of at least two other benches on the western side indicates subsequent changes in the attitude of the limestone.

Ostenfeld described Beata as "consisting of rocks of volcanic origin, being more or less horizontally lying light-colored lava-beds. There is often a short terrace of bare lava-rock; from it the inclination towards the water is nearly vertical, often interrupted by fissures and small caves into which the waves break with much noise." He made mention of the lush green vegetation on the coastal sand, accumulations of *Sesuvium portulacastrum*. Inland from the shore Ostenfeld noted that the most favorable place for the vegetation was in the lee of cliff faces. Above this was the flat but faintly sloping plateau. Ostenfeld climbed the cliff face and found on top a plateau covered with much wind-blown vegetation of low, many-branched trees. He comments, "Many lianas interweave the small trees and numerous cacti and other shrubs are scattered amongst the trees. It was very difficult to make a way through this vegetation, also because it was without any shade at all and extremely hot. The soil surface was nearly bare lava-rock which gave a sonorous sound when we walked on it, and loose soil was found in small holes and deepenings. It was really quite astonishing to find such a comparatively dense plant cover on this rocky surface." Further in his report Ostenfeld relates, "The difficulty in walking in this shade-less vegetation of 3-6 meters high trees, hindered by lianes and the stinging Cacti and other thorny shrubs, prevented me from proceeding far into it. At a distance some slender palms — *Thrinax* or another genus of the same appearance — rose above the low trees, but I could not reach into them. Therefore, I turned back, climbed down the steep cliff-wall to the shore-terrace and examined the vegetation sheltered by the wall." Ostenfeld concludes his report by stating, "Taken as a whole the vegetation shows that the climate must be very dry and probably the rainfall is very low, which together with the strong and constant wind produces the pronounced xeromorphism; but of course no meteorological

data are available. My visit was in winter which probably is the rainy season, but one did not get much impression of that, the only sign may be the shooting of new leaves on some of the *Bursera*-trees and the *Guaiacum*-shrubs."

I had the opportunity during my visit there to cover much more of the island than did Ostenfeld and to penetrate deeper into the spiny shrubland. I established as a starting point for most work the sandy beach area in the northwest corner of the island. This is the location that Ostenfeld mentioned where he saw a number of cotton plants, indicative to him of former cultivation. From this point I worked as far southward as possible on the western side of the island. I also penetrated directly eastward from that starting point and made a long trip around the northern end of the island, working due south from the north towards the interior, later continuing around the northern end and down the eastern side to a point beyond the abandoned salt ponds. Later, with the assistance of the destroyer escort, several landings were made along the west coast at favorable places, and penetration was made directly inland to the cliff face and onto the plateau in three locations.

Sea-level shore lines of Beata Island are of three types: sand, low limestone shelves or benches, and mangrove swamps. Small sandy beaches are common on the west coast (FIG. 2). One of these in the northwest corner of the island is now occupied by several buildings which form the on-shore headquarters of the naval units stationed at Beata. The sailors have attempted to grow some crop plants, but with little success, due to the low nutrients present in the sand and the lack of rainfall. With no accumulation of fresh water anywhere on the island, except in casual rock depressions, the buildings are used as catchments for rain water for the naval personnel. The largest sandy beach observed occurred on the northern end of the island, where on-shore winds have piled the sand on the outcrops of limestone rock.

The vegetation of the sandy beach areas is of the type found commonly in the Antilles (FIG. 2). *Panicum maximum*, an introduced grass, forms the largest stands of greatest height among the herbs. *Opuntia dillenii* occurs commonly at the edges of the grass. *Sesuvium portulacastrum* forms mats of succulent vegetation in open areas. Scattered and individual plants of *Tephrosia cinerea*, *Cenchrus pauciflorus*, *Cassia buchii*, *C. strigillosa*, *Corchorus hirsutus*, *Stachytarpheta jamaicensis*, *Indigofera suffruticosa*, and *Evolvulus alsinoides* occur on the open sand. Extensive development of the herbaceous vines *Ipomoea pes-caprae*, *Echites umbellata*, *Canavalia maritima*, *Passiflora suberosa*, and *Calonyction tuba* cross the open sand, and *Stegnosperma cubense* is rampant in protected areas near the stands of grass. To the rear of the open sand beaches, and especially in more sheltered areas, *Suriana maritima*, *Colubrina ferruginea*, *Lantana reticulata*, *Capparis flexuosa*, *Amyris elemifera*, *Jacquinia barbasco*, *Canella alba*, and *Caesalpinia anacantha* occur.

The limestone shelves are badly eroded and the surface is described as dogtooth limestone. Near the ocean the vegetation on these coastal shelves

is affected by the salt spray, about as described by Ostenfeld. In general all plants on these shelves are stunted and contorted. *Avicennia nitida*, *Amyris elemifera*, *Conocarpus erecta*, *Ernodea littoralis*, and *Rhacoma crossopetalum* are the most common woody plants. *Cyperus nanus*, *C. planifolius*, and *Lithophila muscoides* are the most common herbaceous plants on the limestone benches. Further inland on the limestone benches the effects of the salt spray and the wind are less evident, and the vegetation becomes more luxuriant, approaching in composition that of the plateau area. Evidence of repeated tilting of the island can be found on the western side, where several small cliff faces exist before the main break to the plateau is found. Each cliff face shows undercutting due to previous wave action. These small caves are devoid of vegetation and are extremely dry. It is these caves that seem to be the habitat of the rhinoceros iguana (*Cyclura cornuta*) near the sea.

At the northern end of the island the transition from sand to limestone is gradual and migratory due to the wind action of blowing sand from the beaches onto the gently sloping rock (FIG. 3). The typical succulent beach vegetation gives way to extensive stands of grass and sedge and finally to a belt of pure sedge growth at the edge of the limestone. One of the conspicuous areas of the sedge belt near the limestone was composed of a large stand of *Remirea maritima*. The white bracts of this plant attracted the eye from a considerable distance.

The outcrop of limestone rock at the northern end of the island, exposed as it is to strong winds and salt spray, was occupied by an open stand of shrubby plants (FIG. 4). The rock in this region was heavily creviced and broken. Many of the plants found there were rooted deep down in the cracks with only the crown of the plant protruding. The few plants which did root in the small soil pockets on the limestone were strongly wind-blown, often with branches developing only on the leeward side of the plant. A few species, *Clerodendron spinosum*, *Erithalis vacciniifolia*, *Antirrhoea elliptica*, *Strumpfia maritima*, *Borrchia arborescens*, were found in this area alone on the island. The concentration of the palm *Haitiella ekmanii* in this wind-blown shrub zone was also unusual. *Haitiella* was found commonly in the interior of the island on the limestone plateau, but as scattered or individual plants. In the northern shrub zone just mentioned, however, plants of *Haitiella* were clustered (FIG. 4).

The third coastal type of vegetation, the mangrove swamp formation, was also most common on the northern end of the island. The shallow coastal waters and the gradually ascending beach area have combined to produce the type of shore line best suited to mangrove development. Apparently the profile of the shore line has varied in the past, due to shifting currents and deposition and removal of soil. Some of the mangrove formation is now well inland, and there are other areas of mangrove that are isolated and dead under too exposed and too saline conditions. In the small bay areas along the north coast *Rhizophora*, *Laguncularia*, and *Avicennia* comprise the swamps. None of these species has developed extensively nor are the areas of swamp large. Associated with the mangrove

in drier areas are specimens of *Thespesia populnea*, *Picrodendron macrocarpum*, *Suriana maritima*, and *Amyris elemifera*. Behind the mangroves may be shallow flats covered now with *Batis*, *Sesuvium*, *Salicornia*, and other halophytes. In among the mangroves and elsewhere along the northern coast of Beata are large piles of conch shells. Some of these appear quite old, others more recent. Krieger (l.c.) has mentioned these piles as composed of pure *Strombus gigas*.

The most interesting vegetation on Beata occurred on the central plateau area that Ostenfeld and Wetmore found too difficult to penetrate. Their descriptions of the area, however, are good. The rock surface is almost smooth in places, while in other regions the surface has become badly eroded into sharp edges so characteristic of southern coastal outcrops of limestone on other islands. This is the dogtooth limestone of the Antilles. Ostenfeld noted the peculiarity of this limestone, that is, its metallic ring when struck. Smaller rocks actually ring when hit. The surface of the plateau shows signs of crustal adjustment, with cracks of varying sizes making progress on foot difficult. Crevices eight to ten feet wide were common, and some of these extended approximately sixty feet or more down into the surface. Compression of the island apparently caused piling of large blocks of limestone in other places. Small fractures were evident, and many of these showed additional weathering or erosion due to root action by plants. These smaller cracks had narrow openings but widened downward in contrast to the large crevices, which tapered downward.

The vegetation of this limestone plateau area was complex in its composition (FIG. 5). It is best described as a thorn shrub. The species comprising the vegetation were numerous. While the area seemed barren of flowers or fruit, by careful search the majority of the dominant plants were collected in either flower or fruit and could be identified. One very common tree, assigned to the Leguminosae in the accompanying list, could not be found in fertile condition and remains unidentified. The impression one carries from work on the vegetation of the plateau is that of a thorn-riddled shrub growth. The spiny trunks of *Opuntia moniliformis* were most foreboding in appearance and in the hazard they presented (FIG. 6). Lesser spines occurred on the branches or leaves of *Malpighia setosa*, *Securinega acidoton*, *Guettarda stenophylla*, *G. xanthocarpa*, *Cryptorhiza haitiensis*, *Malpighia domingensis*, *Reynosa cuneifolia*, *Isodorea leonardii*, *Randia parvifolia*, *Hippomane spinosa*, *Trichilia cuneifolia*, *Cameraria angustifolia*, *Caesalpinia anacantha*, and *Cephalocereus polygonus*. In addition the poisonous properties of *Comocladia dodonea*, *C. mollifolia*, *Metopium brownei*, *M. toxiferum*, *Jatropha hernandifolia* and *Hippomane spinosa* were well known, and these plants, too, had to be avoided.

Nowhere on the island did I see trees of fifty to eighty feet as mentioned in the coastal survey report of 1868. The tallest plants were specimens of *Haitiella ekmanii* which stood out in the profile of the forest canopy. These are the "thrinax-like plants" mentioned by Ostenfeld. The largest trees on the island were *Sarcomphalus domingensis*, *Coccoloba pubescens*, *C. diversifolia*, *Bursera simaruba*, and *Ficus populnea* var. *hispaniolae*. A

single specimen of *Clusea rosea*, also one of the more massive plants on Beata, was seen. Around these few conspicuous plants the vegetation consisted of a dense growth of smaller trees and shrubs, much branched and forming an intertangled canopy of branches six to ten feet above the ground. Many of these plants were microphyllous or had leathery shiny leaves. Broad-leaved plants such as *Ulbrichia beatensis* were few. *Comocladia dodonaea* and *C. mollifolia* appeared to be the most numerous. *Cordia buchii* and *Tabebuia ostenfeldii* in full flower presented the most color. The other common species were *Malpighia setosa* and *M. domingensis*, *Capparis flexuosa*, *Krugiodendron ferreum*, *Schoepfia obovata*, *Randia parvifolia*, *Exostemma caribaeum*, *Elaeodendron xylocarpum* (extremely variable in leaf size and shape), *Plumeria obtusa* (also extremely variable), *Securinega acidoton* and *S. neopeltandra*, *Amyris granulata*, *Isodorea leonardii*, *Trichilia cuneifolia*, *Reynosia cuneifolia*, *Samyda pubescens*, *Guettarda xanthocarpa* and *G. stenophylla*. *Opuntia moniliformis* was the only cactus seen in the shrub thickets. Herbaceous growth was conspicuously lacking throughout the interior of the island. *Setaria setosa* was the only grass found in the woodland. *Euphorbia hepatica* and *Commelina diffusa* occurred on the rocks or in pockets of soil. *Zephyranthes bifolia*, a bulbous plant, occurred in small pockets. This plant was not in flower at the time I visited the island, but transplanted bulbs later flowered at Barahona and in the greenhouse in Cambridge. The absence of herbaceous growth was as conspicuous as the extensive development of vines. Much of the progress through the interior was possible only with the continuous stroking of a machete. *Galactia dictyophylla*, *Mesechites repens*, five species of *Cissus*, *Stegnosperma cubense*, *Paullinia jamaicensis*, *Aristolochia bilobata*, and *Chiococca alba* were rampant. Equally troublesome to the foot traveler was the accumulation of dried leaves on the ground. Apparently decay occurred very slowly, for the leaves were deep in many places, and as they hid not only the rough dogtooth surface of the limestone but also the small depressions and many crevices, progress had to be made cautiously.

Epiphytes in general were few in the thorn shrub area. Tillandsias were relatively abundant in a few places but generally scarce when compared with a comparable location elsewhere in Barahona province. Only two species of orchids were found, and these occurred only on the very low branches or the prostrate trunks, as described by Ostenfeld.

Six and a quarter miles to the south of Beata is the island called Alta Vela, occasionally spelled Alto Vela (FIG. 7). From a botanical point of view this island was less interesting than Beata, but historically Alta Vela is better known and has played an often forgotten role in American history.

Alta Vela Island was discovered by Columbus on August 20, 1494. As J. B. Thacher (*Christopher Columbus 2*: 336-7. 1903) describes the event, Columbus "anchored at a small island, or rather a rock which rises singly out of the sea opposite to the long cape stretching southward from the center of the island, to which promontory he gave the name of Cape Beata.

The rock at which he anchored had an appearance at a distance of a tall ship under sail and he called it *Alta Vela*. Several seamen were ordered to climb the rock to watch out for the two lost ships of his squadron. Descending from the summit the sailors killed on the island of *Alta Vela* eight sea wolves which were sleeping on the sands, knocked down many pigeons and other birds with sticks and took others with their hands; for in this unfrequented island the animals seemed to have none of the wildness and timidity which is produced by hostility of man."

As *Alta Vela*, like *Beata*, was destitute of natural water supplies, few ships stopped there except for food or firewood, and no evidence can be found in the literature that the island was ever occupied by other than transients. It is a small island about three quarters of a mile long and a half-mile wide composed originally of a "remarkable bell-shaped hill, the summit 500 feet above sea level." *Alta Vela* Island almost became a possession of the United States in the middle of the nineteenth century, and the dispute over the ownership of it forms an interesting part of American political history. The story is told in detail in the Senate Executive Document No. 38 of the second session of the Fortieth Congress (1868), in Document No. 17 of the third session of the Forty-first Congress (1871), and reviewed in "The United States and Santo Domingo 1798-1873," pages 287-337, by Charles C. Tansill. I am quoting liberally from these documents in summarizing the history of *Alta Vela*.

The United States Congress, on Aug. 18, 1856, passed a law to legalize claims of American citizens to unoccupied islands with guano deposits. The law stated, "When any American citizen chances to discover a deposit of guano on any island, rock or key not within the lawful jurisdiction of any other government and takes peaceful possession thereof, and occupies the same, such island, rock or key may, at the discretion of the President, be considered as appertaining to the United States." As soon as practicable the claimant should give notice to the Department of State of such discovery and occupation describing the island, rock or key and the latitude and longitude thereof as near as may be, and showing that such possession was taken in the name of the United States and should furnish satisfactory evidence to the State Department that such island was not at the time of discovery thereof or the taking possession of and occupation thereof by the claimant in the possession or occupation of any other government. After these conditions were met the discoverer might at the pleasure of Congress be allowed "exclusive rights of occupying such island, rocks or keys for the purpose of obtaining guano and of selling and delivering the same to citizens of the United States."

It was with this law in mind that a schooner owned by the Baltimore firm of Patterson and Murguiendo took possession of *Alta Vela* on Feb. 23, 1860. In May and June the Secretary of State and the State Department of Buchanan's administration were notified that a claim to the uninhabited and unclaimed island was made for the United States. Mining operations were carried on, and when a Dominican vessel stopped at the island in September of that year, its officers were given a sample of the guano. In

early October the Dominican government ordered the Americans to leave the island, which they refused to do, and on the twenty-third of October a vessel of the Dominican government landed troops who arrested the workers and removed the mining equipment. These workers and a company representative sent to obtain their release were held prisoners in Santo Domingo city for nearly thirty days, in spite of promises of safe conduct. The company protested the action to the American Secretary of State. Buchanan's term expired, Johnson became president, and Seward was appointed Secretary of State. Black, the former Secretary, was hired as counsel for the protesting firm. Seward at the time was negotiating with the Dominican government for the use of Samana Bay at the northeast corner of Hispaniola as a United States naval base and was not anxious to force the claim of the previous administration regarding Alta Vela. In fact Seward was thought to be guilty of duplicity when he informed a competing firm, Webster & Co. of New York, that in his opinion the territory under question belonged to the Dominican government. An intimate friend of Seward was found to have a large interest in Webster & Co., and the rage against Seward and Johnson increased when it was learned that the Dominican government had given permission to the Webster company to remove guano from Alta Vela. Patterson and Murguiendo Co., the original claimant to the Alta Vela guano, reported to the State Department that at the current rate of mining and exporting at two thousand tons per month, the guano would soon be exhausted. When the House of Representatives, a few months later on Feb. 24, 1868, agreed on a resolution of impeachment against Johnson, the events which had occurred in Seward's handling of the Alta Vela dispute ranked high. The House Committee on Foreign Affairs, which investigated the dispute, reported, "We are compelled to say that the case is too clear to allow of the least hesitation. Santo Domingo was guilty of an inexcusable outrage upon the rights of the memorialists and a gross insult to the United States." In May of 1869 an appeal was made to Hamilton Fish, the new secretary of state under Grant, for a decision in the case. Finally in May of 1870 Fish reported to the attorneys for Patterson and Murguiendo that all of the documents and pertinent correspondence had been placed before President Grant, who after due consideration determined that no sufficient reason appeared for reconsidering the conclusions heretofore reached.

With that decision Alta Vela dropped from the news. Apparently in due time the guano deposits were mined out. From information and estimates which appeared in the Senate Executive Documents, Alta Vela once contained fifteen thousand tons of guano. An analysis of this material showed it contained 29.16% phosphoric acid and 70.84% lime.

Apparently the mining operation forced the sea birds to change their habits, for no large numbers of them roost on Alta Vela today. The scars of the mining operations on the leeward slopes of the island are still visible, and artifacts of mining still litter portions of the hill (FIG. 10).

Alta Vela, with no wood, water, or fertile soil, remains a desolate outpost. Today a single house and a few small supply buildings take care of the

needs of a lighthouse keeper. The lighthouse at the summit of the hill represents one of the southernmost beacons of the Greater Antilles (FIG. 9).

For the botanist visiting Alta Vela today there is little of interest. The island is bounded by severe wave-washed and undercut cliffs (FIG. 8).

Around the island the bottom drops off sharply, and within a short distance of the shore it consists primarily of boulders offering poor if any anchorage in the heavy seas that continuously wash the island. Landing from the destroyer escort which provided transportation for me proved hazardous, and in fact the vessel stayed under power to hold its position during my visit to the island. Apparently previous occupants of the lighthouse keeper's position tried to grow vegetables and crops of cotton on the slopes on the leeward side. The current keeper informed me he had learned this to be futile, for the lack of sufficient moisture and the frequent dousings with salt spray killed off all his attempted crops.

Alta Vela today has primarily a weedy vegetation. The few woody plants which occurred on the island were located in ravines, primarily on the leeward side of the island (FIG. 10). Those shrubs struggling for existence on the crest of the hill or on the windward side were severely wind-blown and malformed (FIG. 9). These woody plants were few. *Capparis flexuosa* and *C. cynophallophora*, *Ficus populnea*, *Pithecellobium unguis-cati* and *Duranta repens* represented the largest woody plants. *Morinda royoc*, *Iresine angustifolia*, *Eupatorium corymbosum*, and *Sesbania sericea* were the most common plants of low stature. The coastal or flatland areas were dominated by weedy species. In fact the list of twenty species found on Alta Vela and not on Beata would show only pan-Caribbean, if not pan-tropical weeds. There are no evidences of even interesting species of limited range found on the island.

Many of the areas, particularly the mined-out areas on Alta Vela, appeared from the sea to be grassy meadows (FIG. 10.). These were deceptive even from nearer by. The grasses and sedges giving this impression, *Paspalum bakeri*, *P. adspersum*, *Setaria geniculata*, *Cyperus compressus*, *Fimbristylis spathacea*, formed dense stands one to three feet high. However, mixed in with these grasses and hidden by them were extensive mat-like growths of *Opuntia antillana*. *Opuntia dillenii* was common around the edges of these swales. On the exposed rocky outcrops at the sea-cliff margin of the island the vegetation is stunted and consists of the usual halophytes of such areas, *Lithophila muscoides*, *Portulaca oleracea*, *Talinum paniculatum*, *Iresine angustifolia*, and *Sesuvium portulacastrum*. Common in such locations, however, is the turk's cap cactus, *Cactus lemari*.

Alta Vela, by contrast to Beata, has a flora consisting entirely of a woody pauperous vegetation. Whether the island ever had the interesting flora found on Beata is impossible to speculate. Probably its environment was such that shelter was lacking, and only the most hardy of Caribbean plants could grow. Mining operations may have removed some of the vegetation from the sheltered leeward slopes, but the abundance of birds

necessary to produce the guano may also have played a role in the development of the present weedy vegetation.

The vegetation on Alta Vela offers little information regarding the affinities of the flora of the southern coast of Hispaniola, particularly when contrasted with that of Beata.

Beata Island possesses a flora consisting of 118 genera and 168 species, as based on the collection records of Ostenfeld and Howard. The vast majority of the species on Beata are wide-ranging species, but thirty-five of them, representing twenty per cent of the flora, are species of limited distribution and contribute information regarding the affinities of this islet. In addition, three good species are to be currently regarded as endemic to Beata. These are *Ulbrichia beatensis*, *Tabebuia ostenfeldii*, and *Galactia dictyophylla*. One species, *Euphorbia hepatica*, is known elsewhere only from Navassa Island. *Guettarda xanthocarpa*, *G. stenophylla*, *Amyris granulata*, and the hybrid between *Coccoloba uvifera* and *C. pubescens* are known only from the vicinity of Trujin on the Barahona peninsula. *Salicornia bigelovii* has also been collected by Ekman on Gonave Island but is not known from the main island of Hispaniola. Two species, *Elaeodendron ehrenbergii* and *Antirrhoea elliptica*, have been previously collected only in the Cul de Sac, with the latter known only from Isla de Cabritos in Lake Enriquillo.

In general the relationship of the vegetation of Beata Island is with the dry-land shrub vegetation extending from southeastern Haiti through the Barahona peninsula into the Enriquillo valley and eastward to the vicinity of Azua. There is no indication in the Beata flora of affinities with the vegetation of the western end of the southern peninsula of Haiti, a floristically distinct area frequently pointed out by Ekman. Geologically, as well as botanically, Beata appears to be a fragment of recent fracture from the Barahona peninsula.

A comparison of Beata Island with the other islands intensively studied by Ekman reveals that for its small size and lack of topography Beata has indeed a very interesting vegetation. Beata ranks in size with Navassa (*Arkiv för Botanik* 22A (16): 1-12. 1929). The number of species found on Beata is greater, the percentage of endemics about equal; the percentage of introduced or weedy species is much less and the number of interesting species of limited range much higher. The larger size of Gonave Island and the greater range of topography, coupled with its location, have produced a much larger flora, 928 species, than that found on Beata (*Arkiv för Botanik* 23A (6): 1-73. 1930). The same is true of Tortue Island, which has 889 species (*Arkiv för Botanik* 22A (9): 1-61. 1929). Gonave, Tortue, and Navassa are reported to have a soil developed in all or parts of the islands. All seem to receive sufficient rainfall to support the diversified vegetation present. All are in the paths of prevailing winds and currents which would aid the introduction of additional species of plants from the mainland of Hispaniola. Beata stands by contrast. No accurate rainfall records are available for Beata. According to the naval personnel stationed on the island the rainfall is very slight. The catchments estab-

lished on the buildings on Beata do not provide sufficient rainfall for the personnel, and water must be imported. The accumulation of leaves on the surface of the plateau supports the conclusion that sufficient moisture is not available for decay of vegetation. Interestingly, termite action was not noticed on the island. The lack of soil on Beata has prevented the development of a fern flora or of extensive herbaceous growth. The location of Beata, south of the Barahona peninsula, has prevented the introduction of many species from the mainland of Hispaniola by natural transport. Particularly striking in the Beata flora was the complete lack of certain major groups of plants, such as the ferns, and the few examples of epiphytes and palms seen. Families and genera of flowering plants expected in similar dry thorn shrub areas of Hispaniola were also lacking. In particular the absence of members of the Piperaceae, Loranthaceae, Flacourtiaceae, Myrsinaceae, Sapotaceae, Labiatae, Solanaceae, Rutaceae, and Acanthaceae was noted. Characteristic genera such as *Pilea*, *Zanthoxylum*, *Trema*, *Phyllostylon*, *Maytenus*, *Casearia*, *Sideroxylon*, *Bumelia*, *Acacia*, and *Mimosa* were missing from the flora. Additional work on the flora or Beata may be expected to produce additional distributional records, but such work must be accompanied by an examination of the vegetation from Lago Trujin to Punta Beata for comparison. The succession of plant life in the abandoned salt pans should be followed for information on replacement of vegetation in dry-land areas. Nowhere could a study of the development of such a high percentage of toxic and spiny plants as related to the factors of their environment be better attempted.

A LIST OF PLANTS OF BEATA AND ALTA VELA ISLANDS

HYDROCHARITACEAE

Thalassia testudinum Koenig. Beata; *Ostenfeld s.n.*, Howard by observation. — A marine plant particularly common off the north shore in shallow water.

GRAMINEAE

Cenchrus brownii R. & S. Alta Vela; *Howard 12474*.

Cenchrus myosuroides H.B.K. Alta Vela; *Howard 12464*. — Found near the crest of the hill. The stems prostrate, to six feet long.

Cenchrus pauciflorus Benth. Beata; *Howard 12419*. — Plant of open sandy area at the northwest corner of the island. Stems prostrate, radiating.

Panicum adspermum Trin. Alta Vela; *Howard 12462*. — A prostrate plant with radiating branches.

Panicum maximum Jacq. Beata; *Ostenfeld* by observation, *Howard 12389*. — A common grass in areas around bays and old salt pans.

Paspalum bakeri Hackel. Alta Vela; *Howard 12480*. — A common clump grass, perhaps the most abundant and dominant plant on old

guano mined areas. Previously collected on Inagua, Cuba and Barbuda. This is the first record from Hispaniola.

Setaria geniculata (Lam.) Beauv. Alta Vela; *Howard 12471*.

Setaria setosa (Sw.) Beauv. Beata; *Howard 12493*. — Perhaps the only grass growing on limestone in brush thickets. Plants few, scattered.

Sporobolus domingensis (Trin.) Kunth. Beata; *Ostenfeld 330*, Howard by observation. A beach grass dominating sandy areas in the northeast corner of the island. Sterile in August.

Sporobolus pyramidatus (Lam.) Hitch. Alta Vela; *Howard 12460*. — A rare plant; only one specimen seen on the lee side of the island.

CYPERACEAE

Cyperus compressus L. Alta Vela; *Howard 12465*. — An uncommon sedge found on rocks near the lighthouse.

Cyperus nanus Willd. Beata; *Howard 12400*. A single specimen found on the limestone benches near the coast.

Cyperus planifolius L. C. Rich. Beata; *Howard 12447*. Alta Vela; *Howard 12467*. A clump-forming plant found on sand, especially in swales on Beata. On Alta Vela this species is more common, being found in large colonies on the leeward slopes where guano had been mined. This area has been burned frequently, and the charred bases of these plants give the hill a blackened appearance from the sea.

Fimbristylis spathacea Roth. Alta Vela; *Howard 12466*. — A sedge occurring from sea level to the crest of the island. More abundant at the lower elevations.

Mariscus bruneus (Sw.) Clarke. Beata; *Ostenfeld 318, 339*.

Remirea maritima Aubl. Beata; *Howard 12427*. — This unusual sedge was particularly common in the grassy areas in the northeast corner of Beata Island on sand at the edge of limestone. The white bracts cause the plant to be conspicuous even from a distance. The species has been reported previously only from the vicinity of Barahona on Hispaniola. One locality record is known from Puerto Rico. The species is more common in Trinidad, South America, and Africa.

BROMELIACEAE

Tillandsia balbisiana Schl. Beata; *Howard 12349*. — An epiphyte in the shrub thickets.

Tillandsia circinnata Schl. Beata; *Ostenfeld 327*.

Tillandsia recurvata L. Beata; *Howard 12508*. — A common epiphyte found only on the western side of the island on shrubs in the lee of the cliff face.

Tillandsia usneoides L. Beata; *Ostenfeld 315, Howard 12380*. An epiphyte of general occurrence.

Tillandsia utriculata L. Beata; *Howard* 12374. — The largest epiphyte found in the interior of the island.

COMMELINACEAE

Commelina diffusa Burm. f. Beata; *Howard* 12494. — A fleshy herb found on the limestone in the shrub area away from the coast.

PALMAE

Haitiella ekmanii (Burret) Bailey. Beata; *Howard* 12369, 12420. — Apparently the only palm on Beata Island. At the northern end of the island this species is quite abundant in windswept shrub formations, averaging here ten feet in height. Toward the southern end and in the interior in the shrub thickets the palm reached forty feet in height. This species was known previously only from the southern peninsula of Haiti at Anses-à-Pitre on Morne Savane Lafleur (*Contrib. Gray Herb.* 165: 5-9. 1947).

AMARYLLIDACEAE

Zephyranthes bifolia (Aubl.) Roem. Beata; *Howard* 12499-a. — A bulbous plant occurring in cracks and crevices in the limestone in the interior of Beata. The plant was in sterile condition in August when collected. The bulbs collected were planted and flowered in November in Barahona, while others flowered in March in Cambridge, Mass., allowing positive determination. The species is relatively common on limestone in Hispaniola but is not known elsewhere to me at such a low altitude.

ORCHIDACEAE

Laeliopsis domingensis Lindl. (*Broughtonia domingensis* Rolfe). Beata; *Ostenfeld s.n.*, *Howard* 12402, 12428. — An epiphyte of the shrub area, widespread on the island. Ostenfeld notes that these plants occur primarily on the lower branches or trunks of the shrubs. I can verify that this seems to be the pattern of occurrence of the species on the island.

Oncidium intermedium Bert. Beata; *Howard* 12518. — Locally abundant in the thorn shrub areas along the western coast of the island.

ULMACEAE

Celtis trinervia Lam. Beata; *Howard* 12372. — Trees of fifteen feet with green fruit. In the thorn shrub areas on limestone.

MORACEAE

Ficus populnea Willd. var. *hispaniolae* Urb. Beata; *Howard* 12516. Alta Vela; *Howard* 12482. — A twenty-foot tree on Beata Island occurring in the thorn shrub. The striking dark green foliage makes

this plant conspicuous in the thickets. On Alta Vela this species is generally found on the windswept eastern slopes, where plants from one to fifteen feet tall were seen.

URTICACEAE

Rousselia humilis (Sw.) Urb. Beata; *Howard 12375*.—One of the few terrestrial herbs in the limestone areas.

OLACACEAE

Schoepfia obovata Wr. Beata; *Howard 12383*.—An exceedingly common shrub of thorn thickets. Plants occur to eight feet tall.

ARISTOLOCHIACEAE

Aristolochia bilobata L. Beata; *Howard 12366*.—A sterile vine with distinctive foliage.

POLYGONACEAE

Coccoloba diversifolia Jacq. Beata; *Howard 12361*.—A common tree fifteen to twenty-five feet in height in thickets on limestone.

Coccoloba pubescens L. Beata; *Howard 12352*.—One of the largest trees on Beata Island reaching twenty-five feet in height. It occurs on the limestone from the benches of the west coast to the center of the island.

Coccoloba subcordata (DC.) Lind. Beata; *Howard 12488*.—Prostrate or ascending shrubs occurring on the limestone plateau.

Coccoloba uvifera L. Beata; *Howard 12489*. Alta Vela; *Howard 12453*.—Trees reaching fifteen feet are found along the coast in sandy areas.

Coccoloba uvifera × *C. pubescens*. Beata; *Howard 12499*.—This new hybrid was first discovered south of El Caiman on Barahona peninsula, where several stands of the plant had developed between colonies of the parents. The hybrid is a true intermediate with the leaf shape of *C. uvifera* but the venation and texture of *C. pubescens*. The fruits were all sterile but of the size and shape of those of *C. uvifera*. Only a single specimen, eight feet tall, was found on Beata at the southern end of the sandy strip which occurs on the northwest corner of the island.

CHENOPODIACEAE

Atriplex pentandra (Jacq.) Standl. Beata; *Howard 12451*.—A single plant was found on the rocks of the coastal bench. Moscoso lists this plant without specific location in his catalogue of plants from the island. This is the first specimen of this species I have collected in Hispaniola.

Salicornia bigelovii Torr. Beata; *Howard 12442*.—A relatively abundant species mixed with *Batis* and *Sesuvium* along the lagoon

near the salt pans. Moscoso does not record this species from Hispaniola although Ekman collected it on Gonave Island near Trois Louis. Ekman reported the species was not found on the mainland, although it is found on the Atlantic coast of the United States and in Cuba. This collection represents the second record from Hispaniola, but again from an island, not the mainland.

AMARANTACEAE

Amaranthus gracilis Desf. Alta Vela; *Howard* 12458. — This species occurred as a weed in an old field on Alta Vela. Moscoso does not list it in his Catalogue, although I have now collected the taxon at Manzanilla and in the Enriquillo basin. Ekman found the same species on Gonave.

Celosia nitida Vahl. Beata; *Ostenfeld* 320.

Iresine angustifolia Euph. Alta Vela; *Howard* 12456. — The species occurs as a weed on the area disturbed by guano mining.

Lithophila muscoides Sw. Beata: *Ostenfeld* 345, *Howard* 12426. Alta Vela, *Howard* 12461. — On both Beata and Alta Vela this species was a prostrate plant of limestone coastal benches.

NYCTAGINACEAE

Boerhaavia caribaea Jacq. Beata; *Howard* 12487. Alta Vela; *Howard* 12472. — A sporadic weed occurring primarily in the grassy areas.

Neea subcoccinea Heimerl. Beata; *Howard* 12379. — Characteristic shrub of limestone plateau. Plants to eight feet tall with widespreading branches. This species is apparently endemic to Barahona province and has been recorded previously only from that vicinity.

BATIDACEAE

Batis maritima L. Beata; *Howard* by observation. — A common woody perennial along the lagoon and edges of the salt pans on Beata.

PHYTOLACCACEAE

Rivina humilis L. Alta Vela; *Howard* 12476. — Plants to two feet tall were relatively common in the sheltered areas on Alta Vela.

Stegnosperma cubense A. Rich. (*Stegnosperma halimifolium* auct.). Beata; *Ostenfeld* 319, *Howard* 12507. — A trailing or scrambling fleshy-stemmed to woody bush quite common at the edge of the sand and limestone on the western coast of Beata Island. Moscoso does not give a specific location for the occurrence of this species in Hispaniola. D. J. Rogers (*Ann. Mo. Bot. Gard.* 36: 475. 1949) cites two collections by *Fairchild*, numbers 2605 and 2606, from Beata Island. He likewise records collections by Ekman from Massif des Cahos, Barahona, and Sierra de Ocoa.

Playfair in his *Geography* (6: 625. 1814) states, "On Beata the soil is good and was once in a state of cultivation. Till the fall of Santo Domingo, it was the great resort of French privateers." As recently as 1918 Otto Schoenrich (*Santo Domingo, A Country with a Future*, pages 113-114) described Beata as follows: "The island is covered with dense forests in which wild cattle abound. During the sixteenth and seventeenth centuries the island was a convenient resort for the pirates that infested the Spanish main; at one time it is said to have contained fine plantations, but at the present it is only occasionally visited by Dominican or Haitian fishermen." These reports are hard to believe in the light of a present-day examination of the island.

Only two modern visits to the island have been made by botanists, to the best of my knowledge, although zoologists and anthropologists have been there more frequently. The Danish Oceanographical Expedition with the steamer Dana explored the warmer parts of the Caribbean Sea and the Gulf of Panama in 1921 and 1922. Strong trade winds forced this ship to seek shelter on the west side of Beata on Feb. 22, 1922, and apparently it was anchored in essentially the same spot that Columbus chose. One of the botanists aboard this ship was C. H. Ostenfeld, who took advantage of the two-day lay-over to collect marine algae and to make a short visit ashore. The specimens of flowering plants which he collected were described by Urban in the *Dansk Botanisk Arkiv* 4(7): 1-37. 1924. Ostenfeld reports that they landed at the northwest corner of the island. "No inhabited human dwellings were to be seen but a grassy area mostly covered with *Panicum* (*maximum?*) and scattered cotton plants shew that formerly culture had existed here." Ostenfeld indicated throughout his brief report that the island was a difficult place to travel on or to collect plants.

Between 1929 and 1934 the expeditions sponsored by Allison Armour on his yacht the Utowana made several stops at Beata Island. I have been unable to date these specifically and have been able to locate only four records of plants collected during these visits. Thomas Barbour in his privately printed book, "Allison Armour and the Utowana," refers to his visits to Beata aboard the Utowana in the spring of 1929 and again in April of 1934. In 1932 the Utowana apparently made another visit to Beata Island, for one of the plants collected by the botanists aboard, David Fairchild and P. H. Dorsett, proved to be new and was described as a new genus *Armouria* (= *Ulbrichia*) of the Malvaceae. Mr. Harold Loomis, director of the Plant Introduction Station of the U. S. Department of Agriculture at Coconut Grove, Florida, was also on this expedition and introduced seeds of this new genus for cultivation in Florida. David Rogers, in his revision of *Stegnosperma* of the Phytolaccaceae, cites two other collections from Beata Island by these men. No collectors' lists or field books have been located for this expedition, although a gap of twelve numbers occurs between the *Stegnosperma* and *Armouria* collections.*

* After this paper was prepared I had the opportunity of visiting Mrs. David Fairchild at Coconut Grove and Mr. Harold Loomis at the Plant Introduction Station, also in Coconut Grove, Florida. Mrs. Fairchild kindly made Dr. David Fairchild's

Herbert W. Krieger, in an article on the Culture Sequences in Haiti (Smithsonian Institution Publication 3134: 113-124. 1932) refers to Beata Island and publishes a photograph of the shell mounds of pure *Strombus gigas* on the island. I was unable to determine the source of this photograph or the nature of the expedition. Alexander Wetmore visited Beata for a time in the spring of 1931, as he reports in the Smithsonian Institution Publication 3134: 45-54. 1932. He and his party hired a sailboat and sailed for Barahona. Wetmore illustrated a small settlement called Ocrik on Beata Island and reported that his party stayed in one of the houses. The settlement at Ocrik was not in evidence during my visit in 1950. Wetmore's description of the vegetation indicated that it has changed little since Ostenfeld's visit, as he reports, "Thorny bushes, trees and vines growing from the scanty soil accumulated in crevices in the rock form a jungle so dense that it may be penetrated only along trails cut laboriously into the interior."

Thus I seem to be the first botanist to make a deliberate attempt to visit this island and to make comprehensive collections. I am not satisfied

field notes for this expedition available to me for study. She was also able to refer to photographs made on Beata Island, and her recollections of the Utowana's stay at Beata were most pleasant and helpful. Mr. Loomis, also, was able to refer to field books for information on his collections as a member of the party, and he had some excellent photographs of the area. From the field notes of Dr. Fairchild and Mr. Loomis I was able to prepare a numerical list of their collections on Beata, and Mr. E. C. Leonard of the U. S. National Herbarium has been most helpful in checking the herbarium for these specimens. He was not able to locate all of them, and in some cases in the following list field determinations are given. I am most indebted to Mrs. Fairchild, Mr. Loomis, and Mr. Leonard for their assistance.

The Utowana, with Fairchild, Dorsett and Loomis as botanists, stopped at Beata Island on January 17th and March 22nd, 1932. Only a single collection was made by Loomis on the latter date. He collected six numbers on the island on January 17th. Number 15 was identified in the field as *Coccothrinax ekmanii*. This is currently called *Haitiella ekmanii*. The specimen was not located in the National Herbarium. Numbers 16, 17, 18, 19 and 20 collected by Mr. Loomis were species of *Gossypium*. No material could be located at the National Herbarium. On March 22, 1932, Mr. Loomis collected a single number, 94, representing *Pseudophoenix saonae*. Mr. Loomis stated that Cook was in doubt regarding this identification at the time, but Mr. Leonard reports that a specimen so identified is in the National Herbarium.

The following collections by Fairchild and Dorsett were all made on Beata Island on January 17, 1932. Specimens present in the National Herbarium are indicated with an asterisk. All other names represent field identifications from Dr. Fairchild's field notebooks: 2603, *Guilandina ovalifolia*; 2604, *Opuntia moniliformis*; 2605, *Stegnosperma cubense**; 2606, *Stegnosperma cubense**. Number 2606 in Fairchild's field notebook is identified as *Zanthoxylum* sp. A specimen with the same number is cited by Rogers and is in the National Herbarium as *Stegnosperma cubense*. No. 2607, *Capparis flexuosa**; 2608, *Plumeria obtusa* var. *obtusa**; 2609, *Tribulus cistoides*; 2610, *Bromelia* sp.; 2611, *Exogonium eriospermum**; 2612, *Canavalia maritima**; 2613, *Maytenus reynosioides**; 2614, *Coccothrinax ekmanii*; 2615, *Rhynchosia minima**; 2616, *Indigofera suffruticosa**; 2617, *Ulbrichia beatensis**.

One addition can be made to the list of species from Beata Island given in this paper, on the basis of the Fairchild and Dorsett collections available in the National Herbarium. *Rhynchosia minima* (L.) DC. should be added to the Leguminosae.

that I have mastered the flora, however, and wish to pay a return visit at a different season.

Beata today appears from the sea to be a low flat island (FIG. 1). It is a large block of limestone which apparently has been tilted by coastal adjustments. The island is approximately five miles long and three miles broad, according to the skipper of the "27 de Febrero." It is shaped like a wedge of pie, broadest at the northern end and slightly rounded at the south. The north end (FIG. 3) is a sandy plain, at sea level, interrupted by shallow bays now filled with marine succulents and mangroves. The eastern side, likewise, is mostly level with the sea. The greatest elevation is approximately three hundred feet, at the southwest corner. The entire western side of the island shows a series of wave-cut benches with an escarpment of fifty to two hundred feet running from the coast at the north to a point well inland at the southern end of the island (FIG. 2). The surface of this major block is essentially flat, tilting slightly to the northeast. It appears, therefore, that this block of limestone has been tilted by sinkings on the northern and eastern edges. The first crustal adjustment was the most severe, but evidence of at least two other benches on the western side indicates subsequent changes in the attitude of the limestone.

Ostenfeld described Beata as "consisting of rocks of volcanic origin, being more or less horizontally lying light-colored lava-beds. There is often a short terrace of bare lava-rock; from it the inclination towards the water is nearly vertical, often interrupted by fissures and small caves into which the waves break with much noise." He made mention of the lush green vegetation on the coastal sand, accumulations of *Sesuvium portulacastrum*. Inland from the shore Ostenfeld noted that the most favorable place for the vegetation was in the lee of cliff faces. Above this was the flat but faintly sloping plateau. Ostenfeld climbed the cliff face and found on top a plateau covered with much wind-blown vegetation of low, many-branched trees. He comments, "Many lianas interweave the small trees and numerous cacti and other shrubs are scattered amongst the trees. It was very difficult to make a way through this vegetation, also because it was without any shade at all and extremely hot. The soil surface was nearly bare lava-rock which gave a sonorous sound when we walked on it, and loose soil was found in small holes and deepenings. It was really quite astonishing to find such a comparatively dense plant cover on this rocky surface." Further in his report Ostenfeld relates, "The difficulty in walking in this shade-less vegetation of 3-6 meters high trees, hindered by lianes and the stinging Cacti and other thorny shrubs, prevented me from proceeding far into it. At a distance some slender palms — *Thrinax* or another genus of the same appearance — rose above the low trees, but I could not reach into them. Therefore, I turned back, climbed down the steep cliff-wall to the shore-terrace and examined the vegetation sheltered by the wall." Ostenfeld concludes his report by stating, "Taken as a whole the vegetation shows that the climate must be very dry and probably the rainfall is very low, which together with the strong and constant wind produces the pronounced xeromorphism; but of course no meteorological

data are available. My visit was in winter which probably is the rainy season, but one did not get much impression of that, the only sign may be the shooting of new leaves on some of the *Bursera*-trees and the *Guaiacum*-shrubs."

I had the opportunity during my visit there to cover much more of the island than did Ostenfeld and to penetrate deeper into the spiny shrubland. I established as a starting point for most work the sandy beach area in the northwest corner of the island. This is the location that Ostenfeld mentioned where he saw a number of cotton plants, indicative to him of former cultivation. From this point I worked as far southward as possible on the western side of the island. I also penetrated directly eastward from that starting point and made a long trip around the northern end of the island, working due south from the north towards the interior, later continuing around the northern end and down the eastern side to a point beyond the abandoned salt ponds. Later, with the assistance of the destroyer escort, several landings were made along the west coast at favorable places, and penetration was made directly inland to the cliff face and onto the plateau in three locations.

Sea-level shore lines of Beata Island are of three types: sand, low limestone shelves or benches, and mangrove swamps. Small sandy beaches are common on the west coast (FIG. 2). One of these in the northwest corner of the island is now occupied by several buildings which form the on-shore headquarters of the naval units stationed at Beata. The sailors have attempted to grow some crop plants, but with little success, due to the low nutrients present in the sand and the lack of rainfall. With no accumulation of fresh water anywhere on the island, except in casual rock depressions, the buildings are used as catchments for rain water for the naval personnel. The largest sandy beach observed occurred on the northern end of the island, where on-shore winds have piled the sand on the outcrops of limestone rock.

The vegetation of the sandy beach areas is of the type found commonly in the Antilles (FIG. 2). *Panicum maximum*, an introduced grass, forms the largest stands of greatest height among the herbs. *Opuntia dillenii* occurs commonly at the edges of the grass. *Sesuvium portulacastrum* forms mats of succulent vegetation in open areas. Scattered and individual plants of *Tephrosia cinerea*, *Cenchrus pauciflorus*, *Cassia buchii*, *C. strigillosa*, *Corchorus hirsutus*, *Stachytarpheta jamaicensis*, *Indigofera suffruticosa*, and *Evolvulus alsinoides* occur on the open sand. Extensive development of the herbaceous vines *Ipomoea pes-caprae*, *Echites umbellata*, *Canavalia maritima*, *Passiflora suberosa*, and *Calonyction tuba* cross the open sand, and *Stegnosperma cubense* is rampant in protected areas near the stands of grass. To the rear of the open sand beaches, and especially in more sheltered areas, *Suriana maritima*, *Colubrina ferruginea*, *Lantana reticulata*, *Capparis flexuosa*, *Amyris elemifera*, *Jacquinia barbasco*, *Canella alba*, and *Caesalpinia anacantha* occur.

The limestone shelves are badly eroded and the surface is described as dogtooth limestone. Near the ocean the vegetation on these coastal shelves

is affected by the salt spray, about as described by Ostenfeld. In general all plants on these shelves are stunted and contorted. *Avicennia nitida*, *Amyris elemifera*, *Conocarpus erecta*, *Ernodea littoralis*, and *Rhacoma crossopetalum* are the most common woody plants. *Cyperus nanus*, *C. planifolius*, and *Lithophila muscoides* are the most common herbaceous plants on the limestone benches. Further inland on the limestone benches the effects of the salt spray and the wind are less evident, and the vegetation becomes more luxuriant, approaching in composition that of the plateau area. Evidence of repeated tilting of the island can be found on the western side, where several small cliff faces exist before the main break to the plateau is found. Each cliff face shows undercutting due to previous wave action. These small caves are devoid of vegetation and are extremely dry. It is these caves that seem to be the habitat of the rhinoceros iguana (*Cyclura cornuta*) near the sea.

At the northern end of the island the transition from sand to limestone is gradual and migratory due to the wind action of blowing sand from the beaches onto the gently sloping rock (FIG. 3). The typical succulent beach vegetation gives way to extensive stands of grass and sedge and finally to a belt of pure sedge growth at the edge of the limestone. One of the conspicuous areas of the sedge belt near the limestone was composed of a large stand of *Remirea maritima*. The white bracts of this plant attracted the eye from a considerable distance.

The outcrop of limestone rock at the northern end of the island, exposed as it is to strong winds and salt spray, was occupied by an open stand of shrubby plants (FIG. 4). The rock in this region was heavily creviced and broken. Many of the plants found there were rooted deep down in the cracks with only the crown of the plant protruding. The few plants which did root in the small soil pockets on the limestone were strongly wind-blown, often with branches developing only on the leeward side of the plant. A few species, *Clerodendron spinosum*, *Erithalis vacciniifolia*, *Antirrhoea elliptica*, *Strumpfia maritima*, *Borrchia arborescens*, were found in this area alone on the island. The concentration of the palm *Haitiella ekmanii* in this wind-blown shrub zone was also unusual. *Haitiella* was found commonly in the interior of the island on the limestone plateau, but as scattered or individual plants. In the northern shrub zone just mentioned, however, plants of *Haitiella* were clustered (FIG. 4).

The third coastal type of vegetation, the mangrove swamp formation, was also most common on the northern end of the island. The shallow coastal waters and the gradually ascending beach area have combined to produce the type of shore line best suited to mangrove development. Apparently the profile of the shore line has varied in the past, due to shifting currents and deposition and removal of soil. Some of the mangrove formation is now well inland, and there are other areas of mangrove that are isolated and dead under too exposed and too saline conditions. In the small bay areas along the north coast *Rhizophora*, *Laguncularia*, and *Avicennia* comprise the swamps. None of these species has developed extensively nor are the areas of swamp large. Associated with the mangrove

in drier areas are specimens of *Thespesia populnea*, *Picrodendron macrocarpum*, *Suriana maritima*, and *Amyris elemifera*. Behind the mangroves may be shallow flats covered now with *Batis*, *Sesuvium*, *Salicornia*, and other halophytes. In among the mangroves and elsewhere along the northern coast of Beata are large piles of conch shells. Some of these appear quite old, others more recent. Krieger (l.c.) has mentioned these piles as composed of pure *Strombus gigas*.

The most interesting vegetation on Beata occurred on the central plateau area that Ostenfeld and Wetmore found too difficult to penetrate. Their descriptions of the area, however, are good. The rock surface is almost smooth in places, while in other regions the surface has become badly eroded into sharp edges so characteristic of southern coastal outcrops of limestone on other islands. This is the dogtooth limestone of the Antilles. Ostenfeld noted the peculiarity of this limestone, that is, its metallic ring when struck. Smaller rocks actually ring when hit. The surface of the plateau shows signs of crustal adjustment, with cracks of varying sizes making progress on foot difficult. Crevices eight to ten feet wide were common, and some of these extended approximately sixty feet or more down into the surface. Compression of the island apparently caused piling of large blocks of limestone in other places. Small fractures were evident, and many of these showed additional weathering or erosion due to root action by plants. These smaller cracks had narrow openings but widened downward in contrast to the large crevices, which tapered downward.

The vegetation of this limestone plateau area was complex in its composition (FIG. 5). It is best described as a thorn shrub. The species comprising the vegetation were numerous. While the area seemed barren of flowers or fruit, by careful search the majority of the dominant plants were collected in either flower or fruit and could be identified. One very common tree, assigned to the Leguminosae in the accompanying list, could not be found in fertile condition and remains unidentified. The impression one carries from work on the vegetation of the plateau is that of a thorn-riddled shrub growth. The spiny trunks of *Opuntia moniliformis* were most foreboding in appearance and in the hazard they presented (FIG. 6). Lesser spines occurred on the branches or leaves of *Malpighia setosa*, *Securinega acidoton*, *Guettarda stenophylla*, *G. xanthocarpa*, *Cryptorhiza haitiensis*, *Malpighia domingensis*, *Reynosia cuneifolia*, *Isodorea leonardii*, *Randia parvifolia*, *Hippomane spinosa*, *Trichilia cuneifolia*, *Cameraria angustifolia*, *Caesalpinia anacantha*, and *Cephalocereus polygonus*. In addition the poisonous properties of *Comocladia dodonea*, *C. mollifolia*, *Metopium brownei*, *M. toxiferum*, *Jatropha hernandifolia* and *Hippomane spinosa* were well known, and these plants, too, had to be avoided.

Nowhere on the island did I see trees of fifty to eighty feet as mentioned in the coastal survey report of 1868. The tallest plants were specimens of *Haitiella ekmanii* which stood out in the profile of the forest canopy. These are the "thrinax-like plants" mentioned by Ostenfeld. The largest trees on the island were *Sarcomphalus domingensis*, *Coccoloba pubescens*, *C. diversifolia*, *Bursera simaruba*, and *Ficus populnea* var. *hispaniolae*. A

single specimen of *Clusea rosea*, also one of the more massive plants on Beata, was seen. Around these few conspicuous plants the vegetation consisted of a dense growth of smaller trees and shrubs, much branched and forming an intertangled canopy of branches six to ten feet above the ground. Many of these plants were microphyllous or had leathery shiny leaves. Broad-leaved plants such as *Ulbrichia beatensis* were few. *Comocladia dodonaea* and *C. mollifolia* appeared to be the most numerous. *Cordia buchii* and *Tabebuia ostenfeldii* in full flower presented the most color. The other common species were *Malpighia setosa* and *M. domingensis*, *Capparis flexuosa*, *Krugiodendron ferreum*, *Schoepfia obovata*, *Randia parvifolia*, *Exostemma caribaeum*, *Elaeodendron xylocarpum* (extremely variable in leaf size and shape), *Plumeria obtusa* (also extremely variable), *Securinega acidoton* and *S. neopeltandra*, *Amyris granulata*, *Isodorea leonardii*, *Trichilia cuneifolia*, *Reynosia cuneifolia*, *Samyda pubescens*, *Guettarda xanthocarpa* and *G. stenophylla*. *Opuntia moniliformis* was the only cactus seen in the shrub thickets. Herbaceous growth was conspicuously lacking throughout the interior of the island. *Setaria setosa* was the only grass found in the woodland. *Euphorbia hepatica* and *Commelina diffusa* occurred on the rocks or in pockets of soil. *Zephyranthes bifolia*, a bulbous plant, occurred in small pockets. This plant was not in flower at the time I visited the island, but transplanted bulbs later flowered at Barahona and in the greenhouse in Cambridge. The absence of herbaceous growth was as conspicuous as the extensive development of vines. Much of the progress through the interior was possible only with the continuous stroking of a machete. *Galactia dictyophylla*, *Mesechites repens*, five species of *Cissus*, *Stegnosperma cubense*, *Paullinia jamaicensis*, *Aristolochia bilobata*, and *Chiococca alba* were rampant. Equally troublesome to the foot traveler was the accumulation of dried leaves on the ground. Apparently decay occurred very slowly, for the leaves were deep in many places, and as they hid not only the rough dogtooth surface of the limestone but also the small depressions and many crevices, progress had to be made cautiously.

Epiphytes in general were few in the thorn shrub area. Tillandsias were relatively abundant in a few places but generally scarce when compared with a comparable location elsewhere in Barahona province. Only two species of orchids were found, and these occurred only on the very low branches or the prostrate trunks, as described by Ostenfeld.

Six and a quarter miles to the south of Beata is the island called Alta Vela, occasionally spelled Alto Vela (FIG. 7). From a botanical point of view this island was less interesting than Beata, but historically Alta Vela is better known and has played an often forgotten role in American history.

Alta Vela Island was discovered by Columbus on August 20, 1494. As J. B. Thacher (*Christopher Columbus 2: 336-7*. 1903) describes the event, Columbus "anchored at a small island, or rather a rock which rises singly out of the sea opposite to the long cape stretching southward from the center of the island, to which promontory he gave the name of Cape Beata.

The rock at which he anchored had an appearance at a distance of a tall ship under sail and he called it *Alta Vela*. Several seamen were ordered to climb the rock to watch out for the two lost ships of his squadron. Descending from the summit the sailors killed on the island of *Alta Vela* eight sea wolves which were sleeping on the sands, knocked down many pigeons and other birds with sticks and took others with their hands; for in this unfrequented island the animals seemed to have none of the wildness and timidity which is produced by hostility of man."

As *Alta Vela*, like *Beata*, was destitute of natural water supplies, few ships stopped there except for food or firewood, and no evidence can be found in the literature that the island was ever occupied by other than transients. It is a small island about three quarters of a mile long and a half-mile wide composed originally of a "remarkable bell-shaped hill, the summit 500 feet above sea level." *Alta Vela* Island almost became a possession of the United States in the middle of the nineteenth century, and the dispute over the ownership of it forms an interesting part of American political history. The story is told in detail in the Senate Executive Document No. 38 of the second session of the Fortieth Congress (1868), in Document No. 17 of the third session of the Forty-first Congress (1871), and reviewed in "The United States and Santo Domingo 1798-1873," pages 287-337, by Charles C. Tansill. I am quoting liberally from these documents in summarizing the history of *Alta Vela*.

The United States Congress, on Aug. 18, 1856, passed a law to legalize claims of American citizens to unoccupied islands with guano deposits. The law stated, "When any American citizen chances to discover a deposit of guano on any island, rock or key not within the lawful jurisdiction of any other government and takes peaceful possession thereof, and occupies the same, such island, rock or key may, at the discretion of the President, be considered as appertaining to the United States." As soon as practicable the claimant should give notice to the Department of State of such discovery and occupation describing the island, rock or key and the latitude and longitude thereof as near as may be, and showing that such possession was taken in the name of the United States and should furnish satisfactory evidence to the State Department that such island was not at the time of discovery thereof or the taking possession of and occupation thereof by the claimant in the possession or occupation of any other government. After these conditions were met the discoverer might at the pleasure of Congress be allowed "exclusive rights of occupying such island, rocks or keys for the purpose of obtaining guano and of selling and delivering the same to citizens of the United States."

It was with this law in mind that a schooner owned by the Baltimore firm of Patterson and Murguendo took possession of *Alta Vela* on Feb. 23, 1860. In May and June the Secretary of State and the State Department of Buchanan's administration were notified that a claim to the uninhabited and unclaimed island was made for the United States. Mining operations were carried on, and when a Dominican vessel stopped at the island in September of that year, its officers were given a sample of the guano. In

early October the Dominican government ordered the Americans to leave the island, which they refused to do, and on the twenty-third of October a vessel of the Dominican government landed troops who arrested the workers and removed the mining equipment. These workers and a company representative sent to obtain their release were held prisoners in Santo Domingo city for nearly thirty days, in spite of promises of safe conduct. The company protested the action to the American Secretary of State. Buchanan's term expired, Johnson became president, and Seward was appointed Secretary of State. Black, the former Secretary, was hired as counsel for the protesting firm. Seward at the time was negotiating with the Dominican government for the use of Samana Bay at the northeast corner of Hispaniola as a United States naval base and was not anxious to force the claim of the previous administration regarding Alta Vela. In fact Seward was thought to be guilty of duplicity when he informed a competing firm, Webster & Co. of New York, that in his opinion the territory under question belonged to the Dominican government. An intimate friend of Seward was found to have a large interest in Webster & Co., and the rage against Seward and Johnson increased when it was learned that the Dominican government had given permission to the Webster company to remove guano from Alta Vela. Patterson and Murguiendo Co., the original claimant to the Alta Vela guano, reported to the State Department that at the current rate of mining and exporting at two thousand tons per month, the guano would soon be exhausted. When the House of Representatives, a few months later on Feb. 24, 1868, agreed on a resolution of impeachment against Johnson, the events which had occurred in Seward's handling of the Alta Vela dispute ranked high. The House Committee on Foreign Affairs, which investigated the dispute, reported, "We are compelled to say that the case is too clear to allow of the least hesitation. Santo Domingo was guilty of an inexcusable outrage upon the rights of the memorialists and a gross insult to the United States." In May of 1869 an appeal was made to Hamilton Fish, the new secretary of state under Grant, for a decision in the case. Finally in May of 1870 Fish reported to the attorneys for Patterson and Murguiendo that all of the documents and pertinent correspondence had been placed before President Grant, who after due consideration determined that no sufficient reason appeared for reconsidering the conclusions heretofore reached.

With that decision Alta Vela dropped from the news. Apparently in due time the guano deposits were mined out. From information and estimates which appeared in the Senate Executive Documents, Alta Vela once contained fifteen thousand tons of guano. An analysis of this material showed it contained 29.16% phosphoric acid and 70.84% lime.

Apparently the mining operation forced the sea birds to change their habits, for no large numbers of them roost on Alta Vela today. The scars of the mining operations on the leeward slopes of the island are still visible, and artifacts of mining still litter portions of the hill (FIG. 10).

Alta Vela, with no wood, water, or fertile soil, remains a desolate outpost. Today a single house and a few small supply buildings take care of the

needs of a lighthouse keeper. The lighthouse at the summit of the hill represents one of the southernmost beacons of the Greater Antilles (FIG. 9).

For the botanist visiting Alta Vela today there is little of interest. The island is bounded by severe wave-washed and undercut cliffs (FIG. 8).

Around the island the bottom drops off sharply, and within a short distance of the shore it consists primarily of boulders offering poor if any anchorage in the heavy seas that continuously wash the island. Landing from the destroyer escort which provided transportation for me proved hazardous, and in fact the vessel stayed under power to hold its position during my visit to the island. Apparently previous occupants of the lighthouse keeper's position tried to grow vegetables and crops of cotton on the slopes on the leeward side. The current keeper informed me he had learned this to be futile, for the lack of sufficient moisture and the frequent dousings with salt spray killed off all his attempted crops.

Alta Vela today has primarily a weedy vegetation. The few woody plants which occurred on the island were located in ravines, primarily on the leeward side of the island (FIG. 10). Those shrubs struggling for existence on the crest of the hill or on the windward side were severely wind-blown and malformed (FIG. 9). These woody plants were few. *Capparis flexuosa* and *C. cynophallophora*, *Ficus populnea*, *Pithecellobium unguis-cati* and *Duranta repens* represented the largest woody plants. *Morinda royoc*, *Iresine angustifolia*, *Eupatorium corymbosum*, and *Sesbania sericea* were the most common plants of low stature. The coastal or flatland areas were dominated by weedy species. In fact the list of twenty species found on Alta Vela and not on Beata would show only pan-Caribbean, if not pan-tropical weeds. There are no evidences of even interesting species of limited range found on the island.

Many of the areas, particularly the mined-out areas on Alta Vela, appeared from the sea to be grassy meadows (FIG. 10.). These were deceptive even from nearer by. The grasses and sedges giving this impression, *Paspalum bakeri*, *P. adpersum*, *Setaria geniculata*, *Cyperus compressus*, *Fimbristylis spathacea*, formed dense stands one to three feet high. However, mixed in with these grasses and hidden by them were extensive mat-like growths of *Opuntia antillana*. *Opuntia dillenii* was common around the edges of these swales. On the exposed rocky outcrops at the sea-cliff margin of the island the vegetation is stunted and consists of the usual halophytes of such areas, *Lithophila muscoides*, *Portulaca oleracea*, *Talinum paniculatum*, *Iresine angustifolia*, and *Sesuvium portulacastrum*. Common in such locations, however, is the turk's cap cactus, *Cactus lemari*.

Alta Vela, by contrast to Beata, has a flora consisting entirely of a woody pauperous vegetation. Whether the island ever had the interesting flora found on Beata is impossible to speculate. Probably its environment was such that shelter was lacking, and only the most hardy of Caribbean plants could grow. Mining operations may have removed some of the vegetation from the sheltered leeward slopes, but the abundance of birds

necessary to produce the guano may also have played a role in the development of the present weedy vegetation.

The vegetation on Alta Vela offers little information regarding the affinities of the flora of the southern coast of Hispaniola, particularly when contrasted with that of Beata.

Beata Island possesses a flora consisting of 118 genera and 168 species, as based on the collection records of Ostenfeld and Howard. The vast majority of the species on Beata are wide-ranging species, but thirty-five of them, representing twenty per cent of the flora, are species of limited distribution and contribute information regarding the affinities of this islet. In addition, three good species are to be currently regarded as endemic to Beata. These are *Ulbrichia beatensis*, *Tabebuia ostensfeldii*, and *Galactia dictyophylla*. One species, *Euphorbia hepatica*, is known elsewhere only from Navassa Island. *Guettarda xanthocarpa*, *G. stenophylla*, *Amyris granulata*, and the hybrid between *Coccoloba uvifera* and *C. pubescens* are known only from the vicinity of Trujin on the Barahona peninsula. *Salicornia bigelovii* has also been collected by Ekman on Gonave Island but is not known from the main island of Hispaniola. Two species, *Elaeodendron ehrenbergii* and *Antirrhoea elliptica*, have been previously collected only in the Cul de Sac, with the latter known only from Isla de Cabritos in Lake Enriquillo.

In general the relationship of the vegetation of Beata Island is with the dry-land shrub vegetation extending from southeastern Haiti through the Barahona peninsula into the Enriquillo valley and eastward to the vicinity of Azua. There is no indication in the Beata flora of affinities with the vegetation of the western end of the southern peninsula of Haiti, a floristically distinct area frequently pointed out by Ekman. Geologically, as well as botanically, Beata appears to be a fragment of recent fracture from the Barahona peninsula.

A comparison of Beata Island with the other islands intensively studied by Ekman reveals that for its small size and lack of topography Beata has indeed a very interesting vegetation. Beata ranks in size with Navassa (*Arkiv för Botanik* 22A (16): 1-12. 1929). The number of species found on Beata is greater, the percentage of endemics about equal; the percentage of introduced or weedy species is much less and the number of interesting species of limited range much higher. The larger size of Gonave Island and the greater range of topography, coupled with its location, have produced a much larger flora, 928 species, than that found on Beata (*Arkiv för Botanik* 23A (6): 1-73. 1930). The same is true of Tortue Island, which has 889 species (*Arkiv för Botanik* 22A (9): 1-61. 1929). Gonave, Tortue, and Navassa are reported to have a soil developed in all or parts of the islands. All seem to receive sufficient rainfall to support the diversified vegetation present. All are in the paths of prevailing winds and currents which would aid the introduction of additional species of plants from the mainland of Hispaniola. Beata stands by contrast. No accurate rainfall records are available for Beata. According to the naval personnel stationed on the island the rainfall is very slight. The catchments estab-

lished on the buildings on Beata do not provide sufficient rainfall for the personnel, and water must be imported. The accumulation of leaves on the surface of the plateau supports the conclusion that sufficient moisture is not available for decay of vegetation. Interestingly, termite action was not noticed on the island. The lack of soil on Beata has prevented the development of a fern flora or of extensive herbaceous growth. The location of Beata, south of the Barahona peninsula, has prevented the introduction of many species from the mainland of Hispaniola by natural transport. Particularly striking in the Beata flora was the complete lack of certain major groups of plants, such as the ferns, and the few examples of epiphytes and palms seen. Families and genera of flowering plants expected in similar dry thorn shrub areas of Hispaniola were also lacking. In particular the absence of members of the Piperaceae, Loranthaceae, Flacourtiaceae, Myrsinaceae, Sapotaceae, Labiatae, Solanaceae, Rutaceae, and Acanthaceae was noted. Characteristic genera such as *Pilea*, *Zanthoxylum*, *Trema*, *Phyllostylon*, *Maytenus*, *Casearia*, *Sideroxylon*, *Bumelia*, *Acacia*, and *Mimosa* were missing from the flora. Additional work on the flora or Beata may be expected to produce additional distributional records, but such work must be accompanied by an examination of the vegetation from Lago Trujin to Punta Beata for comparison. The succession of plant life in the abandoned salt pans should be followed for information on replacement of vegetation in dry-land areas. Nowhere could a study of the development of such a high percentage of toxic and spiny plants as related to the factors of their environment be better attempted.

A LIST OF PLANTS OF BEATA AND ALTA VELA ISLANDS

HYDROCHARITACEAE

Thalassia testudinum Koenig. Beata; *Ostenfeld s.n.*, Howard by observation. — A marine plant particularly common off the north shore in shallow water.

GRAMINEAE

Cenchrus brownii R. & S. Alta Vela; *Howard 12474*.

Cenchrus myosuroides H.B.K. Alta Vela; *Howard 12464*. — Found near the crest of the hill. The stems prostrate, to six feet long.

Cenchrus pauciflorus Benth. Beata; *Howard 12419*. — Plant of open sandy area at the northwest corner of the island. Stems prostrate, radiating.

Panicum adspermum Trin. Alta Vela; *Howard 12462*. — A prostrate plant with radiating branches.

Panicum maximum Jacq. Beata; *Ostenfeld* by observation, *Howard 12389*. — A common grass in areas around bays and old salt pans.

Paspalum bakeri Hackel. Alta Vela; *Howard 12480*. — A common clump grass, perhaps the most abundant and dominant plant on old

guano mined areas. Previously collected on Inagua, Cuba and Barbuda. This is the first record from Hispaniola.

Setaria geniculata (Lam.) Beauv. Alta Vela; *Howard* 12471.

Setaria setosa (Sw.) Beauv. Beata; *Howard* 12493. — Perhaps the only grass growing on limestone in brush thickets. Plants few, scattered.

Sporobolus domingensis (Trin.) Kunth. Beata; *Ostenfeld* 330, *Howard* by observation. A beach grass dominating sandy areas in the northeast corner of the island. Sterile in August.

Sporobolus pyramidatus (Lam.) Hitch. Alta Vela; *Howard* 12460. — A rare plant; only one specimen seen on the lee side of the island.

CYPERACEAE

Cyperus compressus L. Alta Vela; *Howard* 12465. — An uncommon sedge found on rocks near the lighthouse.

Cyperus nanus Willd. Beata; *Howard* 12400. A single specimen found on the limestone benches near the coast.

Cyperus planifolius L. C. Rich. Beata; *Howard* 12447. Alta Vela; *Howard* 12467. A clump-forming plant found on sand, especially in swales on Beata. On Alta Vela this species is more common, being found in large colonies on the leeward slopes where guano had been mined. This area has been burned frequently, and the charred bases of these plants give the hill a blackened appearance from the sea.

Fimbristylis spathacea Roth. Alta Vela; *Howard* 12466. — A sedge occurring from sea level to the crest of the island. More abundant at the lower elevations.

Mariscus bruneus (Sw.) Clarke. Beata; *Ostenfeld* 318, 339.

Remirea maritima Aubl. Beata; *Howard* 12427. — This unusual sedge was particularly common in the grassy areas in the northeast corner of Beata Island on sand at the edge of limestone. The white bracts cause the plant to be conspicuous even from a distance. The species has been reported previously only from the vicinity of Barahona on Hispaniola. One locality record is known from Puerto Rico. The species is more common in Trinidad, South America, and Africa.

BROMELIACEAE

Tillandsia balbisiana Schl. Beata; *Howard* 12349. — An epiphyte in the shrub thickets.

Tillandsia circinnata Schl. Beata; *Ostenfeld* 327.

Tillandsia recurvata L. Beata; *Howard* 12508. — A common epiphyte found only on the western side of the island on shrubs in the lee of the cliff face.

Tillandsia usneoides L. Beata; *Ostenfeld* 315, *Howard* 12380. An epiphyte of general occurrence.

Tillandsia utriculata L. Beata; *Howard* 12374. — The largest epiphyte found in the interior of the island.

COMMELINACEAE

Commelina diffusa Burm. f. Beata; *Howard* 12494. — A fleshy herb found on the limestone in the shrub area away from the coast.

PALMAE

Haitiella ekmanii (Burret) Bailey. Beata; *Howard* 12369, 12420. — Apparently the only palm on Beata Island. At the northern end of the island this species is quite abundant in windswept shrub formations, averaging here ten feet in height. Toward the southern end and in the interior in the shrub thickets the palm reached forty feet in height. This species was known previously only from the southern peninsula of Haiti at Anses-à-Pitre on Morne Savane Lafleur (*Contrib. Gray Herb.* 165: 5-9. 1947).

AMARYLLIDACEAE

Zephyranthes bifolia (Aubl.) Roem. Beata; *Howard* 12499-a. — A bulbous plant occurring in cracks and crevices in the limestone in the interior of Beata. The plant was in sterile condition in August when collected. The bulbs collected were planted and flowered in November in Barahona, while others flowered in March in Cambridge, Mass., allowing positive determination. The species is relatively common on limestone in Hispaniola but is not known elsewhere to me at such a low altitude.

ORCHIDACEAE

Laeliopsis domingensis Lindl. (*Broughtonia domingensis* Rolfe). Beata; *Ostenfeld s.n.*, *Howard* 12402, 12428. — An epiphyte of the shrub area, widespread on the island. Ostenfeld notes that these plants occur primarily on the lower branches or trunks of the shrubs. I can verify that this seems to be the pattern of occurrence of the species on the island.

Oncidium intermedium Bert. Beata; *Howard* 12518. — Locally abundant in the thorn shrub areas along the western coast of the island.

ULMACEAE

Celtis trinervia Lam. Beata; *Howard* 12372. — Trees of fifteen feet with green fruit. In the thorn shrub areas on limestone.

MORACEAE

Ficus populnea Willd. var. *hispaniolae* Urb. Beata; *Howard* 12516. Alta Vela; *Howard* 12482. — A twenty-foot tree on Beata Island occurring in the thorn shrub. The striking dark green foliage makes

this plant conspicuous in the thickets. On Alta Vela this species is generally found on the windswept eastern slopes, where plants from one to fifteen feet tall were seen.

URTICACEAE

Rousselia humilis (Sw.) Urb. Beata; *Howard* 12375. — One of the few terrestrial herbs in the limestone areas.

OLACACEAE

Schoepfia obovata Wr. Beata; *Howard* 12383. — An exceedingly common shrub of thorn thickets. Plants occur to eight feet tall.

ARISTOLOCHIACEAE

Aristolochia bilobata L. Beata; *Howard* 12366. — A sterile vine with distinctive foliage.

POLYGONACEAE

Coccoloba diversifolia Jacq. Beata; *Howard* 12361. — A common tree fifteen to twenty-five feet in height in thickets on limestone.

Coccoloba pubescens L. Beata; *Howard* 12352. — One of the largest trees on Beata Island reaching twenty-five feet in height. It occurs on the limestone from the benches of the west coast to the center of the island.

Coccoloba subcordata (DC.) Lind. Beata; *Howard* 12488. — Prostrate or ascending shrubs occurring on the limestone plateau.

Coccoloba uvifera L. Beata; *Howard* 12489. Alta Vela; *Howard* 12453. — Trees reaching fifteen feet are found along the coast in sandy areas.

Coccoloba uvifera × *C. pubescens*. Beata; *Howard* 12499. — This new hybrid was first discovered south of El Caiman on Barahona peninsula, where several stands of the plant had developed between colonies of the parents. The hybrid is a true intermediate with the leaf shape of *C. uvifera* but the venation and texture of *C. pubescens*. The fruits were all sterile but of the size and shape of those of *C. uvifera*. Only a single specimen, eight feet tall, was found on Beata at the southern end of the sandy strip which occurs on the northwest corner of the island.

CHENOPODIACEAE

Atriplex pentandra (Jacq.) Standl. Beata; *Howard* 12451. — A single plant was found on the rocks of the coastal bench. Moscoso lists this plant without specific location in his catalogue of plants from the island. This is the first specimen of this species I have collected in Hispaniola.

Salicornia bigelovii Torr. Beata; *Howard* 12442. — A relatively abundant species mixed with *Batis* and *Sesuvium* along the lagoon

near the salt pans. Moscoso does not record this species from Hispaniola although Ekman collected it on Gonave Island near Trois Louis. Ekman reported the species was not found on the mainland, although it is found on the Atlantic coast of the United States and in Cuba. This collection represents the second record from Hispaniola, but again from an island, not the mainland.

AMARANTACEAE

Amaranthus gracilis Desf. Alta Vela; *Howard* 12458. — This species occurred as a weed in an old field on Alta Vela. Moscoso does not list it in his Catalogue, although I have now collected the taxon at Manzanilla and in the Enriquillo basin. Ekman found the same species on Gonave.

Celosia nitida Vahl. Beata; *Ostenfeld* 320.

Iresine angustifolia Euph. Alta Vela; *Howard* 12456. — The species occurs as a weed on the area disturbed by guano mining.

Lithophila muscoides Sw. Beata: *Ostenfeld* 345, *Howard* 12426. Alta Vela, *Howard* 12461. — On both Beata and Alta Vela this species was a prostrate plant of limestone coastal benches.

NYCTAGINACEAE

Boerhaavia caribaea Jacq. Beata; *Howard* 12487. Alta Vela; *Howard* 12472. — A sporadic weed occurring primarily in the grassy areas.

Neea subcoccinea Heimerl. Beata; *Howard* 12379. — Characteristic shrub of limestone plateau. Plants to eight feet tall with widespreading branches. This species is apparently endemic to Barahona province and has been recorded previously only from that vicinity.

BATIDACEAE

Batis maritima L. Beata; *Howard* by observation. — A common woody perennial along the lagoon and edges of the salt pans on Beata.

PHYTOLACCACEAE

Rivina humilis L. Alta Vela; *Howard* 12476. — Plants to two feet tall were relatively common in the sheltered areas on Alta Vela.

Stegnosperma cubense A. Rich. (*Stegnosperma halimifolium* auct.). Beata; *Ostenfeld* 319, *Howard* 12507. — A trailing or scrambling fleshy-stemmed to woody bush quite common at the edge of the sand and limestone on the western coast of Beata Island. Moscoso does not give a specific location for the occurrence of this species in Hispaniola. D. J. Rogers (*Ann. Mo. Bot. Gard.* 36: 475. 1949) cites two collections by *Fairchild*, numbers 2605 and 2606, from Beata Island. He likewise records collections by Ekman from Massif des Cahos, Barahona, and Sierra de Ocoa.

AIZOACEAE

Sesuvium portulacastrum L. Beata; Ostenfeld and Howard by observation. — A common fleshy herb on sandy areas and occasionally on the limestone coastal benches.

PORTULACACEAE

Portulaca oleracea L. Beata; *Ostenfeld 344, Howard 12450*. — A common weed around the buildings in the northwest corner of Beata.

Portulaca phaeosperma Urb. Beata; *Ostenfeld 346, Howard 12405*. — A fleshy herb of sand and of limestone coastal benches.

Talinum paniculatum (Jacq.) Gaertn. Alta Vela; *Howard 12477*. — A stout herb of hillsides on both windward and leeward sides.

ANNONACEAE

Annona bicolor Urb. Beata; *Howard 12356*. — A shrub of the limestone plateau. Plants to fifteen feet tall with attractive reddish purple flowers. This species had previously been reported only from the vicinity of Barahona.

LAURACEAE

Cassytha americana Nees. Beata; *Howard 12417*. — An orange-colored parasitic vine on shrubs of the coastal limestone benches.

CRUCIFERAE

Cakile lanceolata (Willd.) Schulz. Beata; *Howard 12444*. — A fleshy herb of sandy areas at the northwest corner of Beata.

CAPPARIDACEAE

Capparis cynophallophora L. Beata; *Ostenfeld 309, Howard 12406*. Alta Vela; *Howard 12485*. — This species occurs in the shrub area on the limestone plateau on Beata. It is also the largest and most common tree on the leeward slopes of Alta Vela.

Capparis flexuosa L. Beata; *Ostenfeld 317, Howard 12504, 12393*. Alta Vela; *Howard 12483*. — A common scrambling shrub of the thickets of Beata and on the leeward slopes of Alta Vela.

LEGUMINOSAE

Caesalpinia anacantha Urb. Beata; *Howard 12432*. — One of the common shrubs in the windswept area on limestone at the northern end of Beata. Ekman found this species on Gonave Island and it has been collected at Montagnes du Trou d'Eau in Morne a Cabrits.

Caesalpinia ciliata (Berg.) Urb. Beata; *Ostenfeld 325*. — Previously recorded from Haiti only.

- Caesalpinia glandulosa* Bert. Beata; *Howard 12435*. — A spreading shrub to five feet tall in the windswept shrub area on limestone at the northern end of Beata. Moscoso reports that this species was collected by Bertero in the Dominican Republic, but the location is unknown.
- Canavalia maritima* (Aubl.) Thou. Beata; *Howard 12392*. — A common beach vine on sandy areas of Beata.
- Cassia buchii* Urb. Beata; *Ostenfeld 313, Howard 12448*. — This low shrub was found only on limestone. Urban, in determining the plants collected by Ostenfeld, felt that the Beata plants represented a distinct form. I feel this is an ecological variant due to the habitat.
- Cassia strigillosa* Benth. Beata; *Howard 12399*. — A woody herb of the sandy areas.
- Desmanthus virgatus* (L.) Willd. Beata; *Howard 12433*. — A woody herb becoming five feet tall. In thicket and windswept areas of the plateau.
- Desmodium triflorum* DC. Alta Vela; *Howard 12475*. — A prostrate herb occurring on rocks at the summit of the island.
- Galactia dictyophylla* Urb. Beata; *Ostenfeld 329, 332, Howard 12500*. — This relatively common vine occurs on the limestone cliff faces. The species is endemic to Beata Island.
- Indigofera suffruticosa* Mill. Beata; *Howard 12398*. — A weedy herb of sandy areas, growing to four feet in height.
- Pithecellobium unguis-cati* (L.) Benth. Alta Vela; *Howard 12455*. — A low shrub on the windward slopes of Alta Vela.
- Sesbania sericea* (Willd.) DC. Alta Vela; *Howard 12457*. — A shrub of three feet on the leeward slopes of the island.
- Tephrosia cinerea* (L.) Pers. Beata; *Howard 12423*. — A common woody herb of sandy beaches.

One of the common small trees of Beata Island remains unidentified (*Howard 12384*). This fifteen-foot tree was not in flower or fruit during my visit there. The leaves are evenly pinnate and consist of four to six leaflets. The leaflets are orbicular-rhombic in outline with the midrib placed off the median. The texture of the leaflets is coriaceous and when dry both surfaces are densely reticulate. In appearance the specimens collected resemble *Pithecellobium*, but until fertile material is available the plant remains unidentified.

ERYTHROXYLACEAE

- Erythroxylon areolatum* L. Beata; *Ostenfeld 308, Howard 12360*. — A ten-foot spreading shrub relatively common in limestone plateau thickets.

ZYGOPHYLLACEAE

- Guaiacum sanctum* L. Beata; *Ostenfeld* 304, 305, *Howard* 12502. — Trees of twenty feet in thickness on limestone.
- Tribulus cistoides* L. Beata; *Ostenfeld* 326.

RUTACEAE

- Amyris elemifera* L. Beata; *Howard* 12401. — A shrub of twelve feet occurring on the limestone plateau.
- Amyris granulata* Urb. Beata; *Howard* 12344. — A relatively common shrub of twelve feet occurring on the limestone at all elevations. The species was sterile in August. The type, from Trujin, was collected by Abbott.

SIMARUBACEAE

- Picrodendron macrocarpum* (A. Rich.) Britton. Beata; *Ostenfeld* 293, *Howard* 12430. — A common tree around the old salt pans. Plants reaching fifteen feet with spreading branches.
- Suriana maritima* L. Beata; *Howard*, by observation. — A common shrub of the sandy beaches on the west coast.

BURSERACEAE

- Bursera simaruba* (L.) Sarg. Beata; *Ostenfeld* 253, 322, *Howard* 12515. — Due to its colored bark, this is the most conspicuous tree in the open thorn thickets on limestone.

MELIACEAE

- Trichilia cuneifolia* (L.) Urb. Beata; *Howard* 12388. — A shrub of twelve feet occurring on limestone. Previously reported from Azua to Barahona on Hispaniola.

MALPIGHIACEAE

- Malpighia domingensis* Small. Beata; *Howard* 12346.
- Malpighia setosa* Spreng. Beata; *Howard* 12501.
- Stigmaphyllon lingulatum* (Poir.) Small var. *sericans* Ndz. Beata; *Ostenfeld* 335, *Howard* by observation.

EUPHORBIACEAE

- Croton lucidus* L. Beata; *Howard* 12440. — A four-foot shrub common along the edges of the old salt pans.
- Croton polytomus* Urb. Beata; *Howard* 12407. — Previously reported from Cadets on the northern peninsula of Haiti and considered endemic there. This was a common seven-foot shrub in the thickets.
- Euphorbia buxifolia* Lam. Beata; *Howard* 12445. — An herb of sandy and grassy areas and less frequent on limestone benches.

- Euphorbia hepatica* Urb. Beata; *Howard* 12425. — A prostrate plant growing in small holes in the limestone. This species was based on material collected by Ekman on Navassa Island. This is the second collection recorded for this insular endemic.
- Gymnanthes lucida* Sw. Beata; *Howard* 12505. — A common shrub in thickets, to eight feet tall.
- Hippomane manchinella* L. Beata; Howard by observation. — Common in restricted areas of coastal sand.
- Hippomane spinosa* L. Beata; *Howard* 12385. — A shrub of eight feet to a tree of twenty feet. Common in thickets and thorn shrub on the plateau. This species has been previously collected in Haiti. The toxicity of the sap of this plant far exceeds any of the other dermatitis-producing plants that I have encountered in the Antilles. After collecting specimens from one of the plants seen on Beata, I accidentally ran the sharpened branch through the shoulder of my shirt, without breaking the skin. A few hours later my shoulder became painful, and I discovered that a large blister was developing. Liquid continued to accumulate, forming several blisters, and the largest, by the time it broke, was fully two inches in diameter and an inch high. The amount of liquid that accumulated in the four large blisters produced was copious. A light compress was required for several days to protect the affected area, but no unusual soreness or after-effect was experienced. The sailors who are stationed at Beata Island confirmed the unusual blistering properties of this species and recognized them as being far more severe than those of *Hippomane manchinella*.
- Jatropha hernandifolia* Vent. Beata; *Howard* 12351. — A common weak-structured shrub to eight feet tall. The flowers are white and the mature fruit bright green.
- Jatropha multifida* L. Beata; *Howard* 12376. — It is difficult to believe that this plant, which occurs occasionally in thorn shrub areas of Barahona peninsula and in the plateau area of Beata, is not a native of the region.
- Securinega acidoton* (L.) Fawc. & Rend. Beata; *Howard* 12503. — One of the common very spiny shrubs of the thorn shrub thickets on the plateau.
- Securinega neopeltandra* (Griseb.) Urb. (*Chascotheca domingensis* Urb.). Beata; *Howard* 12358. Alta Vela; *Howard* 12481. — A common low shrub on both Beata and Alta Vela, which was collected in fruit in August.

ANACARDIACEAE

- Comocladia dodonaea* (L.) Urb. Beata; *Ostenfeld* 331, *Howard* 12514.
- Comocladia mollifolia* Ekm. & Helw. Beata; *Howard* 12517. — Barkley, who has studied my collections of *Comocladia*, refers this material to

C. mollifolia, which is based on an Ekman collection from Las Villas province in Cuba. I have previously collected this species from the vicinity of Pedernales. Together these two species of *Comocladia*, represented by spindly shrubs with a characteristic crown of pinnate leaves, represent the most abundant plants in most areas of the limestone plateau.

Metopium brownei (Jacq.) Urb. Beata; *Ostenfeld* 252, 321, *Howard* 12519.

Metopium toxiferum (L.) Krug & Urb. Beata; Howard by observation. — Both species of *Metopium* were observed growing to the rear of the sandy beach areas on the west coast. Both were present, but less abundant, on the limestone plateau.

CELASTRACEAE

Elaeodendron ehrenbergii Urb. Beata; *Ostenfeld* 251, 298, 299, 301, *Howard* 12396. — One of the most common plants in the more fertile sheltered areas back of the sand and coastal benches on the west coast. The plants averaged fifteen feet in height and were colorful with the abundant yellowish fruits.

Elaeodendron xylocarpum (Vent.) DC. Beata; *Howard* 12490. — A six-foot shrub on the limestone plateau. Previously known only from the vicinity of Barahona in Hispaniola but of widespread occurrence in the Antilles.

Maytenus reynosioides Urb. Beata; *Fairchild* 2613. — A microphyllous shrub apparently on the limestone.

Rhacoma crossopetalum L. Beata; *Howard* 12434. — A common shrub on limestone, to seven feet tall.

Schaefferia frutescens Jacq. Beata; *Howard* 12373. — A common shrub to ten feet tall, with red fruit.

SAPINDACEAE

Cardiospermum corindum L. Alta Vela; *Howard* 12486. — A weedy plant on open hillsides.

Paullinia jamaicensis Macf. Beata; *Howard* 12363. — An abundant but localized vine on the plateau. This appears to be the first record of the species from Hispaniola. It has been recorded previously from Jamaica and Cuba.

Sapindus saponaria L. Beata; *Ostenfeld* 307, *Howard* 12397. — A coastal tree of sandy beach areas, to twenty feet tall.

RHAMNACEAE

Colubrina ferruginea Brong. Beata; *Howard* 12390. — A coastal shrub often found with *Rhizophora* and *Thespesia* at the north end of Beata.

- Colubrina reclinata* (L'Her.) Brong. Beata; *Howard* 12496. — A common low shrub of sandy areas along the west coast.
- Krugiodendron ferreum* (Vahl.) Urb. Beata; *Howard* 12342. — A fifteen-foot shrub on the limestone plateau area.
- Reynosia cuneifolia* Urb. & Ekm. Beata; *Howard* 12353. — Abundant in thorn shrub on cliff faces and on the plateau.
- Sarcomphalus domingensis* (Spreng.) Krug & Urb. Beata; *Ostenfeld* 320, *Howard* 12348. Generally a small tree averaging fifteen feet, but with a few very old and large specimens in the dense thickets on the plateau. One of the largest trees on Beata.

VITACEAE

- Cissus caustica* Tussac. Beata; *Howard* 12341.
- Cissus fuertesii* Urb. Beata; *Howard* 12359.
- Cissus macilenta* (Planch.) Urb. Beata; *Ostenfeld* 336.
- Cissus micrantha* Poir. Beata; *Howard* 12362.
- Cissus trifoliata* L. Beata; *Ostenfeld* 311, *Howard* 12513. — These species of *Cissus* were equally abundant all over the island. In many places a single species or combination of them made penetration through the thorn shrub a matter of cutting one's way with a machete.

TILIACEAE

- Corchorus hirsutus* L. Beata; *Howard* 12404. — A shrub of sandy areas, to four feet high.

MALVACEAE

- Gossypium hirsutum* L. var. *punctatum* (Schum.) Hutch. Beata; *Ostenfeld* 324, *Howard* 12438. — A few scattered plants on the northwest corner of Beata led Ostenfeld to conclude that agriculture had been conducted there. Around the salt ponds and in the thorn shrub on the eastern coast of the island these plants are even more abundant, without accompanying evidences of cultivation.
- Sida acuta* Burm. Alta Vela; *Howard* 12470. — Woody herb around the lighthouse.
- Thespesia populnea* (L.) Soland. Beata; *Howard* 12410. — Low to almost prostrate coastal tree near the mangroves.
- Ulbrichia beatensis* Urb. (*Armouria beata* Lewton). Beata; *Ostenfeld* 312, *Howard* 12371. — This species was originally described by Urban from the Ostenfeld collection. The plant was again collected by D. Fairchild and P. H. Dorsett, members of the Allison V. Armour expedition, in 1932 and described by Lewton as a new genus. Both Howard (*Bull. Torr. Club* 76: 89–100. 1949) and Kearney (*Amer. Midl. Nat.* 46: 111. 1951) have discussed this genus. The collection I made in August was sterile, but the species is easily recognized.

STERCULIACEAE

Melochia tomentosa L. Beata; *Howard* 12498. — A common three-foot shrub on limestone, especially in the windswept northern area.

Waltheria americana L. Beata; *Ostenfeld* 314.

GUTTIFERAE

Clusia rosea Jacq. Beata; *Ostenfeld* 296, *Howard* 12364. — A single specimen, a tree of twenty feet, was found on the plateau area.

CANELLACEAE

Canella alba Murr. Beata; *Howard* 12436. — One of the largest trees in the thorn shrub around the salt pans. Plants to fifteen feet tall.

FLACOURTIACEAE

Samyda pubescens L. Beata; *Howard* 12365. — A low shrub of six feet on the limestone. A very attractive shrub when in full flower.

TURNERACEAE

Turnera ulmifolia L. Alta Vela; *Howard* 12469. — A common woody herb with brilliant yellow flowers. Abundant in disturbed areas.

PASSIFLORACEAE

Passiflora suberosa L. Beata; *Howard* 12449. — A fleshy vine on sandy areas and coastal benches.

CACTACEAE

Cactus lemari (Monv.) Brit. & Rose (*Melocactus*). Alta Vela; *Howard* 12459. — An extremely abundant turk's head cactus found on the exposed windward slopes and the south end of Alta Vela. Fruit a characteristic bright pink color.

Cephalocereus polygonus (Lam.) Brit. & Rose. Beata; *Howard* 12492. — A strict or candelabra-branched cactus reaching twenty feet in height. Abundant in open area on the limestone. The fruit is a bright red color.

Opuntia antillana Brit. & Rose. Beata; *Howard* 12408. Alta Vela; *Howard* 12468. — The most common low pad-type cactus on both Beata and Alta Vela. In the guano mined areas of Alta Vela this cactus is extremely abundant, although completely hidden by stands of grass and sedge. It is this cactus that makes progress through the "grassy areas" of both islands treacherous. It was observed that the stem segments of *Opuntia antillana* detach and attach themselves to trousers much more readily than those of *O. dillenii*.

- Opuntia caribaea* Brit. & Rose. Beata; Howard by observation. — This cactus with cylindrical joints was common in many areas of the thorn shrub on the limestone in the shrub thickets of Beata. This is the nastiest of all the cacti in Hispaniola, as the joints detach very readily, and any movement of the plant literally jettisons the spiny segments in all directions.
- Opuntia dillenii* (Ker.-Gawl.) Haw. Beata and Alta Vela; Howard by observation. — This plant is restricted to coastal areas and to areas of former human occupation.
- Opuntia moniliformis* (L.) Haw. Beata; *Howard 12387*. — An extremely common tree-type cactus found in the shrub thickets on the limestone plateau. The trunk of this cactus may be six inches in diameter and is covered with spines two to four inches long. The first branch may occur four to six feet from the ground. The flattened branches develop in all directions, and a thick stand of these plants is almost impossible to penetrate. The small flowers are attractive with the outer perianth parts red and the inner bright orange.

RHIZOPHORACEAE

- Rhizophora mangle* L. Beata; *Howard 12414*. — A coastal shrub most abundant on the north coast.

COMBRETACEAE

- Conocarpus erecta* L. Beata; *Ostenfeld 316, Howard 12340*. — A coastal plant on mud and marl flats. Trees to fifteen feet tall.
- Conocarpus erecta* L. var. *sericea* Griseb. Beata; *Howard 12413*. — Locally abundant at the northern end of Beata. Foliage heavily silky pubescent. Plants to ten feet tall.
- Laguncularia racemosa* (L.) Gaertn. Beata; *Howard 12431*. — Relatively abundant at the edges of the salt pans on the east coast of Beata.

MYRTACEAE

- Cryptorhiza haitiensis* Urb. Beata; *Ekman (August Frett 7063), Howard 12345, 12446*. — This species was described by Urban, based on material collected between Cueva Alta and Trujin and Juan Lopez and Trujin on the Barahona peninsula. Reference is also given in the original publication to a collection made by August Frett on Beata Island. I have been unable to learn anything further about the latter man or the nature or amount of collections he made on Beata. *Cryptorhiza haitiensis* is a common three-foot shrub growing on limestone on Beata Island. All plants were sterile in August. However, the distinctive foliage and aroma of the plant, coupled with the common names of cañelito and cañelillo, allowed determination of the collections. This plant was well known to all the sailors who were my companions. A strong aromatic tea made from the leaves

was recommended for upset stomachs or intestinal disorders; however, the same leaves were brewed into a mild and sweetened tea which we all drank with considerable pleasure nearly every evening aboard the boat.

Eugenia aeruginea DC. Beata; *Ostenfeld* 300.

Eugenia buxifolia (Sw.) Willd. Beata; *Ostenfeld* 300, 302, *Howard* 12347. — A common shrub of twelve feet on the limestone plateau.

Eugenia aff. *fragrans* (Sw.) Willd. Beata; *Howard* 12354, 12343. — An eight- to twelve-foot shrub collected on the marshy ground around the salt pans and on the limestone plateau. Records of this species from Hispaniola are all for higher altitude locations than these from Beata Island.

Eugenia linearis L. C. Rich. Beata; *Ostenfeld* 340, *Howard* 12381. — A fifteen-foot shrub found on the limestone plateau. This species was very common in restricted locations, with many seedlings and saplings in the vicinity. Urban regarded the *Ostenfeld* collection as a narrow-leaved form of the species, but the variation of leaf width with the age of the plant was striking in one colony in the field.

Eugenia rhombea (Berg.) Krug & Urb. Beata; *Howard* 12350. — A common shrub, generally about eight feet tall. It occurred on the limestone, but was most abundant in sheltered areas along the western coast of the island.

THEOPHRASTACEAE

Jacquinia barbasco (Loefl.) Mez. Beata; *Howard* 12409. — Bushes of five feet with abundant red fruits were found along the north coast of the island.

Jacquinia linearis Jacq. Beata; *Howard* 12441. — A small bush two to three feet tall was found in the windswept area along the north coast of the island. This species has not previously been reported from the southern coast of Hispaniola.

APOCYNACEAE

Cameraria angustifolia L. Beata; *Howard* 12403. — This species was illustrated by Burman in *Plantae Americanae* in describing Plumier's plants and was described by Linnaeus (*Sp. Pl.* 210. 1753). Moscoso reports this species was collected by *Robert Schomburgk* (no. 145), but no location was given for the collection. In 1926 Urban described a new species, *Cameraria linearifolia* (*Ark. Bot.* 20A (5): 39. 1926), based on an Ekman collection, which Woodson later reduced to synonymy under *C. angustifolia* (*N. Am. Fl.* 29: 121. 1938). Ekman's material came from Morne Cadets in Haiti. To the best of my knowledge neither Plumier nor Schomburgk was on Beata Island, and so this species may well be expected in the Barahona province,

probably in the Enriquillo valley and possibly in the limestone areas south of Trujin.

The material I collected on Beata Island in August came from a twenty-foot tree. Plants were relatively common in local areas along the cliff on the west coast. The trees were in flower and fruit. A description of the mature fruits has been lacking in the literature. The samara-type fruits were paired, each samara being 22–24 mm. long. The lateral wings, located slightly above the median line of the fruit, are strongly veined. The apex of the samara is emarginate when mature and deeply emarginate-cleft in development. The wings are lobed about one third from the base. The lobes are rounded above and cuneate at the base of the fruit. At the broadest part of the wings the fruit is 11 mm. wide.

Echites umbellata Jacq. Beata; *Howard 12506*.—A woody vine becoming shrubby. The attractive white flowers make this a conspicuous plant on the sandy beaches.

Lochnera rosea (L.) Rchb. Beata; Howard by observation.—An introduced ornamental planted near the buildings in the northwest corner of Beata.

Mesechites repens (Jacq.) Miers. Beata; *Ostenfeld 334*, *Howard 12510*.—A very common vine just back of the sandy beaches and in certain areas of the limestone.

Plumeria obtusa L. (*P. beatensis* Urb., *P. ostenfeldii* Urb.). Beata; *Ostenfeld 249, 341*, *Howard 12424, 12491*.—A common shrub of the limestone area most abundant in the windswept northern end. The number of specimens representing the two collections I made show sufficient variation to support Woodson's reduction of the Urban species (*N. Am. Fl.* 29: 117. 1938).

CONVOLVULACEAE

Calonyction tuba (Schlecht.) Colla. Beata; *Ostenfeld 323*, *Howard 12394*.

Evolvulus alsinoides L. var. *grisebachianus* Meisn. Beata; *Howard 12395*.—Herbaceous plants of sandy beaches, especially on the west coast.

Ipomoea acuminata (Vahl.) R. & S. Beata; *Ostenfeld 333*.

Ipomoea eriosperma (Desr.) Urb. Beata; *Ostenfeld 343*.

Ipomoea pes-caprae (L.) Sweet. Beata; Howard by observation.

Ipomoea tiliacea (Willd.) Choisy. Alta Vela; *Howard 12463*.

Jacquemontia jamaicensis (Jacq.) Hall. Beata; *Howard 12437*.—An abundant vine in thorn shrub on limestone.

BORAGINACEAE

Cordia buchii Urb. Beata; *Howard 12511, 12495*.—A very attractive shrub of twelve feet with red-orange flowers and yellowish fruits

turning orange. Common on the limestone and occurring on the faces of the cliffs.

Bouerreria maritima O. E. Schulz. Beata; *Howard 12378*. — An eight-foot shrub of limestone areas, previously reported only from Cabo Falso and considered a dry-land coastal endemic of Barahona province.

VERBENACEAE

Avicennia nitida Jacq. Beata; *Howard 12412*. — A coastal plant of twelve feet. Most abundant on the north coast.

Citharexylum fruticosum L. Beata; *Howard 12377*. — A shrub of ten feet in height in the thorn shrub.

Clerodendron spinosum (L.) Spreng. Beata; *Howard 12415*. — A low shrub of two feet which seems to occur only in the larger pits in the limestone plateau.

Duranta repens L. Alta Vela; *Howard 12484*. — A common shrub to eight feet in height occurring only on the leeward side of the island.

Lantana reticulata Pers. Beata; *Howard 12391*. — A shrub of three feet occurring on sandy areas.

Stachytarpheta jamaicensis (L.) Vahl. Beata; *Howard 12411*. Alta Vela; *Howard 12473*. A weedy herb of sandy areas near the buildings and the salt pans.

BIGNONIACEAE

Tabebuia ostenfeldii Urb. Beata; *Ostenfeld 342, Howard 12509, 12497*. — A shrub five to six feet tall growing on limestone and especially on the cliff faces. The small grayish foliage coupled with the pale lavender flowers makes this an attractive plant and a rather distinct species. The species is based on the Ostenfeld collection but has also been collected by Ekman on Gonave Island and recorded by him from Anses-à-Pitre on the Barahona peninsula.

RUBIACEAE

Antirrhoea lucida (Sw.) Hook. Beata; *Howard 12382*. — An attractive fifteen-foot tree on limestone.

Antirrhoea elliptica Urb. & Ekman. Beata; *Howard 12418*. A low two-foot shrub occurring abundantly in the low windswept formation at the north end of Beata Island. This species was described from material collected by Ekman on Cabritos Island in Lake Enriquillo. It has not been reported from the Barahona peninsula, and this represents the second record of its occurrence.

Chiococca alba (L.) Hitchc. Beata; *Howard 12367*. Alta Vela; *Howard 12479*. — A common, often stout vine in open thorn shrub throughout the island of Beata. On Alta Vela the species forms a rampant shrub on the lee hillsides.

Ernodea littoralis Sw. Beata; *Howard* 12429.

Exostemma caribaeum (Jacq.) R. & S. Beata; *Howard* 12386. — A fifteen-foot tree in the thorn shrub on the limestone plateau.

Erithalis vacciniifolia (Griseb.) Wr. Beata; *Howard* 12416. — A prostrate woody shrub occurring in large sink areas in the windswept formation at the northern end of Beata Island. The white flowers and shining black fruits make this a particularly attractive plant. This species has previously been known from Cuba. While Standley (N. Am. Fl. 32: 280. 1934) cites Santo Domingo as the known distribution of the species it is not listed by Moscoso, and I have seen no material from this island.

Guettarda stenophylla Urb. Beata; *Howard* 12512. — A five-foot shrub growing on the cliff faces on the western side of Beata Island. Only one previous collection from El Charco del Gato on the Barahona peninsula is known to me.

Guettarda xanthocarpa Britton. Beata; *Howard* 12368. — A fifteen-foot tree in the thorn shrub on the limestone plateau. This species has been collected in several locations on southern Barahona peninsula. Standley refers this species to the synonymy of *G. cueroensis* Britton (N. Am. Fl. 32: 236. 1934), but a field knowledge of both species prompts me to retain *G. xanthocarpa*, as it occurs in Hispaniola, as distinct.

Isidorea leonardii Urban. Beata; *Howard* 12357. — A five-foot shrub on the limestone plateau.

Morinda royoc L. Beata; *Howard* 12439. Alta Vela; *Howard* 12454.

Psychotria nutans Sw. Beata; *Howard* 12355. — A six-foot shrub in thorn shrub on limestone plateau.

Randia parvifolia Lam. Beata; *Howard* 12370. — This eight-foot shrub occurred in the thorn shrub on the limestone plateau.

Strumpfia maritima Jacq. Beata; *Howard* 12421. — A common low shrub in the windswept area at the northern end of Beata Island.

COMPOSITAE

Borrichia arborescens (L.) DC. Beata; *Ostenfeld* 337, *Howard* 12422. — A low shrub occurring at the dried edges of the mangrove swamps.

Eupatorium corymbosum Aubl. Alta Vela; *Howard* 12478. — A very abundant shrub on all areas of Alta Vela.

Tetranthus cupulatus Urb. Beata; *Howard* 12443, 12452. — Previously reported from Paradise on the Barahona peninsula. A white-flowered herb in holes in coastal limestone benches.

EXPLANATION OF PLATES

PLATE I

FIG. 1. Beata Island as seen from the west, midway of its length.

FIG. 2. Sandy beach on the west coast of Beata Island looking to the south. *Ipomoea pes-caprae* is the vine at the edge of the sand. *Coccoloba uvifera* and *Suriana maritima* form the first shrub zone. The major cliff profile is at the right.

PLATE II

FIG. 3. Grass-covered wind-blown sand zone encroaches on the limestone at the north end of Beata Island.

FIG. 4. A shrub zone on the deeply fissured limestone at the north end of Beata Island. Most of the shrubs in the foreground are rooted in crevices. Palms in the background are *Haitiella ekmanii*.

PLATE III

FIG. 5. Thorn shrub vegetation on the plateau area of Beata Island. The large tree at the left is *Bursera simaruba*.

FIG. 6. A group of tree cacti, *Opuntia moniliformis*, on the plateau limestone of Beata Island.

PLATE IV

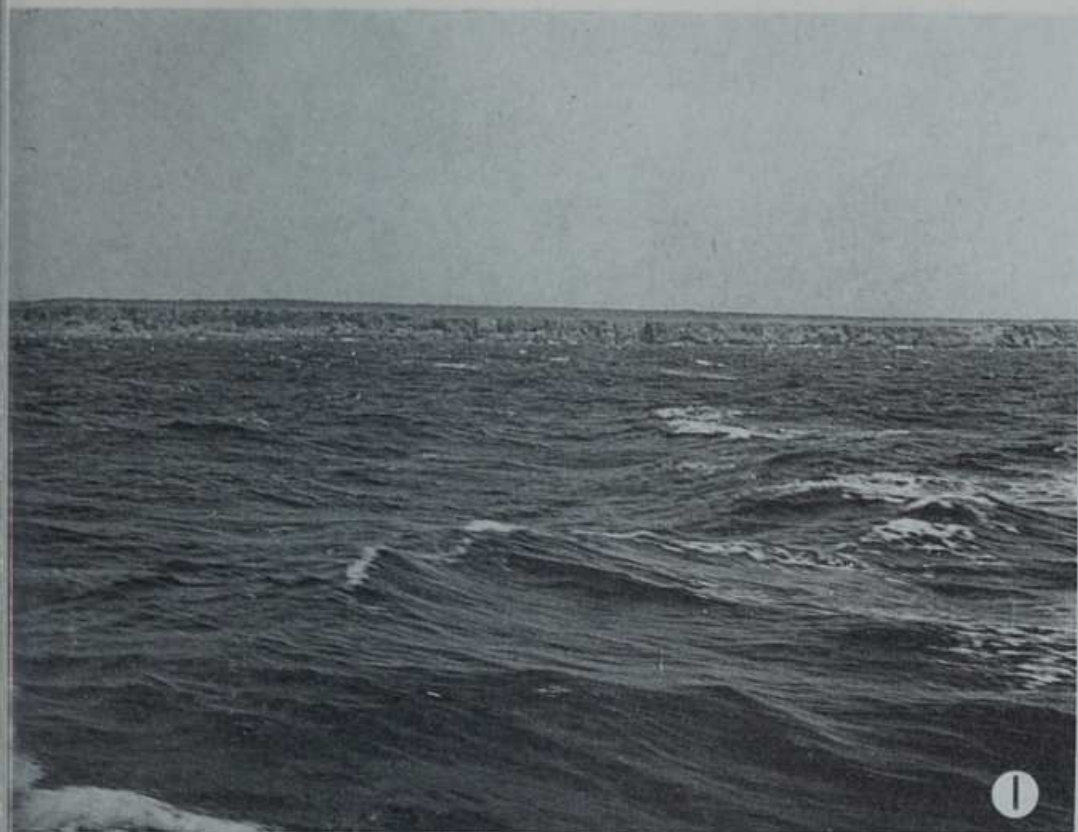
FIG. 7. Alta Vela Island as seen from the north in the pass from Beata Island.

FIG. 8. The typical precipitous shore line of Alta Vela Island. A man in the upper right corner is in an area of turks head cactus, *Cactus lemari*.

PLATE V

FIG. 9. The light-house tower at the crest of Alta Vela. The wind-swept shrub occurs on limestone boulders.

FIG. 10. The southeast corner of Alta Vela showing the scars of the early guano-mining operations still visible. Shrubs in the lee of the hill at the right are *Capparis cynophallophora*. The grassy area near the shore line hides large stands of *Opuntia antillana*. The destroyer escort vessel "27 de Febrero" stands by off shore.



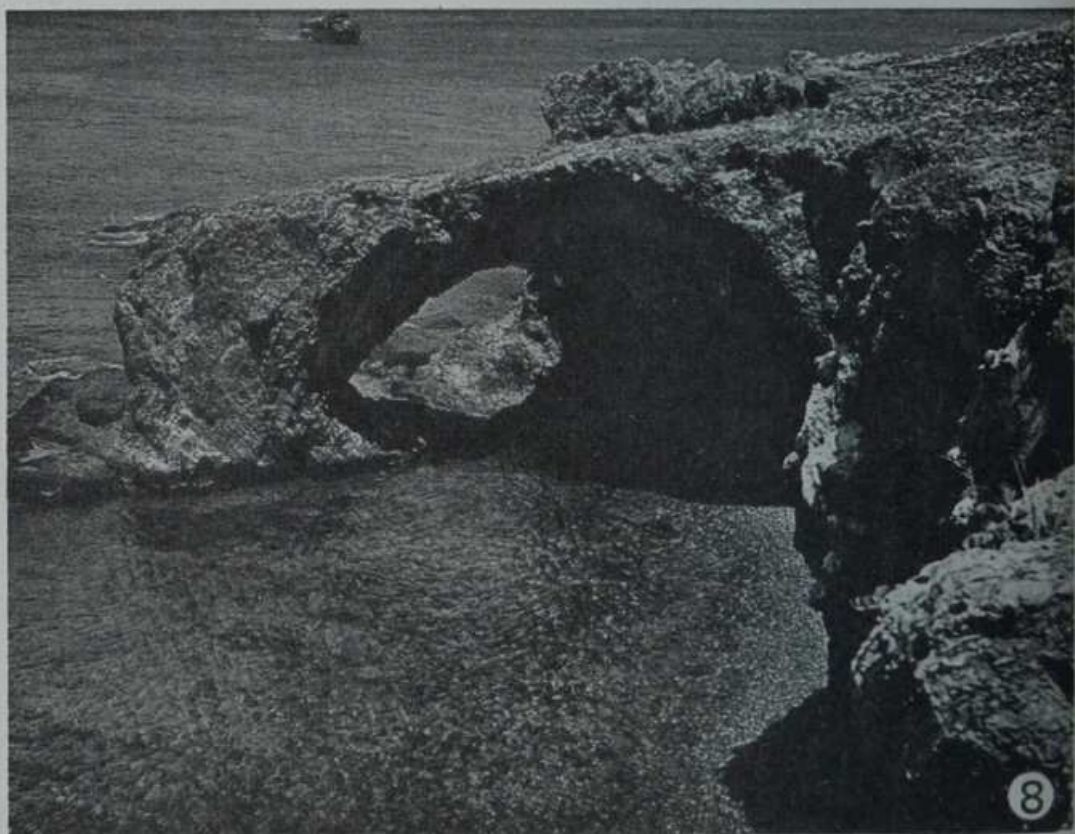
HOWARD, VEGETATION OF BEATA AND ALTA VELA



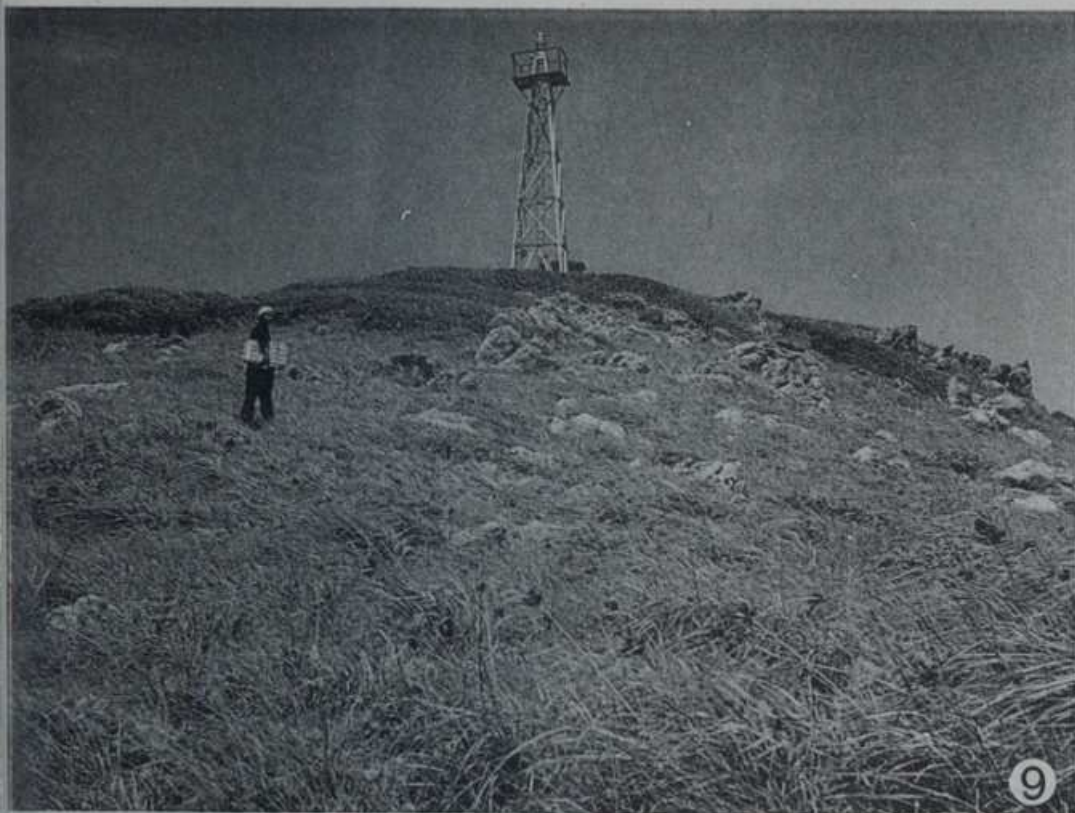
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HOWARD, VEGETATION OF BEATA AND ALTA VELA



HOWARD, VEGETATION OF BEATA AND ALTA VELA



HOWARD, VEGETATION OF BEATA AND ALTA VELA



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