

ALLAN HANCOCK PACIFIC EXPEDITIONS

VOLUME 1

NUMBER 2

GENERAL ACCOUNT OF THE SCIENTIFIC
WORK OF THE *VELERO III* IN THE
EASTERN PACIFIC, 1931-41

PART II

Geographical and Biological Associations
(PLATES 17-128)

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THE UNIVERSITY OF SOUTHERN CALIFORNIA PRESS
LOS ANGELES, CALIFORNIA

1943

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ALLAN HANCOCK PACIFIC EXPEDITIONS
VOLUME 1, NUMBER 2
ISSUED DECEMBER, 1943
PRICE \$3.50

THE UNIVERSITY OF SOUTHERN CALIFORNIA PRESS
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GENERAL ACCOUNT OF THE SCIENTIFIC WORK OF THE *VELERO III* IN THE EASTERN PACIFIC

GEOGRAPHICAL AND BIOLOGICAL ASSOCIATIONS

During the ten years in which the *Velero III* has been in the service of marine exploration in the Eastern Pacific, the ship has traversed a great stretch of coast line, much of it several times. This running description of the coast line, as it is associated with the collecting stations of the *Velero III*, is presented in the hope and expectation that it may be useful for reference to all those who are interested in the voyages of the *Velero III* and in the work of the Allan Hancock Foundation, but particularly to anyone who has been, is, or will be engaged in the detailed examination of any portion of the vast amount of biological material collected on the voyages, and preserved and stored in the Allan Hancock Foundation Building on the campus of The University of Southern California, Los Angeles. The account is intended as a setting for the record of collecting stations, as listed in a later part of this volume.

The principal sources of the information here supplied are the hydrographic survey charts, the three numbers of *Coast Pilot* that cover this part of the coast, photographs taken by photographers and other members of the Hancock Pacific Expeditions, in the possession of the Allan Hancock Foundation, direct observations of various members of these expeditions, and personal observations.

No apology is necessary for the greater detail in reference to the Gulf of California and the Galapagos Islands, since the collecting has been much more concentrated in these regions.

For many of the geographical names there is a lack of agreement in spelling. In cases of disagreement the *Coast Pilot* has been used as the authority, not that the *Coast Pilots* show any phenomenal degree of consistency, but because in them one can always find the name used, and the likelihood is that, as an authority, they are as reliable as, if not more reliable than, any other single authority.

The photographs, reproduced for illustration, have been selected, on the whole, from the extensive photograph library of the Foundation to give some pictorial idea of the nature of the coast described. Additional photographs supplied by the several scientists are so indicated in connection with the brief explanation of each illustration used in this account. One set of charts serves to indicate the routes taken in the longer expeditions, and the other set shows the trend of the whole coast line on a somewhat larger scale.

Distances are always given in geographical miles.

THE VOYAGES OF VELERO III

Since the launching of the *Velero III* in the summer of 1931, use has been made of her to explore the shore and coastal waters of the Pacific coast of the Americas, from the Golden Gate, San Francisco, California, 37° 49' North, 122° 29' West, to Port San Juan, Peru, 15° 20' South, 75° 10' West, a distance of over 4,500 miles; and, if the coast of the Gulf of California is included, as it must be, 1,500 miles should be added. Most of the continental islands have been visited, as well as the oceanic islands, the Revilla Gigedo group (Socorro and Clarion), Clipperton, Cocos, and the several islands of the Galapagos Archipelago.

Thrown in, as an extra that cannot readily be included in the Pacific Expeditions, was a cruise in 1939 through the Panama Canal, east along the coasts of Panama, Colombia, Venezuela, and the Guianas, to the Island of Trinidad and Tobago Island.

Although, particularly in the later expeditions, the main objective has been oceanographic and, especially, biological, abundant opportunity has been provided to collect material and data concerning terrestrial organisms and to observe the habits, customs, arts, and handicrafts of the natives that inhabit the countries bordering on these shores. This account, however, will be almost entirely restricted to the oceanographic work.

On the first expedition, December 3, 1931, to February 27, 1932, the first stop was made at Mazatlan, Mexico, from which the mainland coast line was traversed to Balboa, Canal Zone, hence to the Galapagos Islands and back to Balboa. The return trip was made by way of Cocos Island, up the west coast to the Gulf of California, along the west shore of the Gulf as far as Espiritu Santo Island, then back to port, after calling at Cedros Island on the way. (Expedition Chart 1)

The main object of this expedition was to obtain live animals—vertebrates—for the San Diego Zoological Gardens. There was no special equipment aboard for making any collections of marine invertebrates. Some such collecting was done in addition to collecting of terrestrial species. Insects on land and such shore forms as Crustacea and Mollusks served as a beginning of the collections that have since become so extensive, although this collecting was largely incidental.

The second expedition, December 29, 1932, to March 23, 1933, touched first at Tenacatita, Mexico, passed down the coast to Balboa by way of Malpelo Island to La Libertad, Ecuador, across to the Galapagos Islands by way of Cocos Island back to Balboa, then northwestward along the coast to the home port without entering the Gulf of California. (Expedition Chart 2)

The collecting of marine invertebrates on the first expedition was successful enough to indicate that the Eastern Tropical Pacific offered a fertile field for marine biological exploration, a field up to this time almost untouched. From such an unpretentious beginning, without placing any restraint on work on vertebrates, terrestrial invertebrates, or ethnology, marine biological exploration has come more and more to the fore until, on recent expeditions, this type of investigation, with other cognate oceanographic adherents, is of paramount importance.

Paralleling this development and, to some extent, accounting for it, there has been an increase in the amount and in the efficiency of the equipment carried on the *Velero III*. Suitable auxiliary boat equipment was provided as the ship was built, and this made it an easy matter to fit in any extra equipment necessary.

For the 1933 Expedition much equipment was added—a hand dredge, diving helmet, seines, dipnets, lobster traps, etc., suitable for shallow water as well as intertidal collecting. This brought in its train such an increase in marine invertebrate collecting, with such satisfactory results, that there could no longer be any doubt that the *Velero III* had found its proper niche in scientific endeavor.

The 1934 Expedition, December 30, 1933, to March 14, 1934, took quite a different route, although it covered little new area. The first stop was made at Socorro Island (Revilla Gigedo group), and the second at Clarion in the same group. From Clarion the course was set to Clipper-ton Atoll, and on to the Galapagos Islands. This was the only time that the archipelago was approached by way of Culpepper and Wenman islands, the most northwesterly islands of the group. Three weeks were spent in the Galapagos before proceeding to Guayaquil, Ecuador. The return voyage was made to Balboa, C.Z., and along the coast to the home port without entering the Gulf of California. (Expedition Chart 3)

The greatest improvement in equipment for this cruise was the fitting up of one of the whaleboats with a suitably geared power winch for dredging, a sorting table on the stern, movable shear legs for raising and emptying the dredge, and 250 fathoms of steel cable for hauling the dredge. This equipment made it possible to dredge satisfactorily in water to a depth of 100 fathoms or even more, although that depth was seldom exceeded.

Equipment to take water samples and bottom samples introduced physics and chemistry into the general plan of operations.

The success of this expedition engendered lasting confidence in the work of the expeditions. A sound basis for future work had been fairly and firmly established.

In June of this same year, 1934, a trip was made to the Revilla Gigedo Islands (Socorro and Clarion) to do some summer collecting.

The winter expedition of 1934-35, November 23, 1934, to April 12, 1935, was a long one. Sailing direct from Cedros Island to the Galapagos Islands, the members of the expedition spent over two weeks among the islands before leaving for Puná and Guayaquil, Ecuador, and on southward to Independencia Bay, Peru. On the return trip to port there was little wandering afield from the main coast line. (Expedition Chart 4)

The distinctive feature of this expedition was the visit to the Bird Islands and Bird Rocks along the Peruvian coast.

The route of the 1936 Expedition, February 14, 1936, to March 26, 1936, was largely confined to the Gulf of California. Certain stops were made along the west coast of Lower California; then the west coast of the Gulf of California was followed to Angel de la Guardia Island, across to Tiburon Island on the east side of the Gulf, down to San Pedro Nolasco Island, back again to the west coast of the Gulf to Cape San Lucas and back again to port. (Expedition Chart 5)

This was the first of three expeditions to do intensive as well as extensive collecting in the Gulf of California.

The 1937 Expedition, February 26, 1937, to April 8, 1937, covered somewhat the same general area as did that of 1936. The main attack was made in the Gulf of California. This time both sides of the Gulf were explored as far in as Consag Rock, not very far from the mouth of the Colorado River. On this occasion the east coast of the Gulf was followed as far south as Point Piaxtla before return was made to the west coast of the Gulf on the return journey. (Expedition Chart 6)

In July of this same year, 1937 (July 8 to 21), a trip was made to Cedros Island, Abrejos Point and Pond Lagoon, on the west coast of Lower California, the San Benito Islands, and Guadalupe Island, mainly, but not entirely, to obtain sea lions and elephant seals for the San Diego Zoological Gardens.

The 1938 Expedition, January 3, 1938, to March 13, 1938, was another long cruise, south along the coast to Guatemala, and then by way of Cocos Island to the Galapagos Islands, across to Peru as far south as San Juan Bay, Peru, to visit again the Bird Islands and Rocks. The return trip followed the mainland coast. (Expedition Chart 7)

Further equipment for dredging was used on this expedition for the first time. Facilities for using a much larger dredge directly from the deck of *Velero III* were provided, with 1,200 fathoms of cable, so that satis-

factory dredging could be done at a much greater depth than formerly if the bottom was suitable. The smaller dredge was not discarded, since it could be worked in shallower water and over a much rougher bottom than would be safe for the larger dredge.

In the summer of this year, 1938, the *Velero III* headed north for a change, for a visit to San Francisco. This provided the opportunity to do some collecting, mainly by dredging, in an area not previously entered.

In 1939, March 12 to May 14, Clarion and Socorro islands provided the first bases of operation. From these islands the course was set to Chacahua Bay, Mexico, and southeast along the mainland coast to Balboa, C.Z. (Expedition Chart 8)

Here came the only digression from the Pacific area in the ten years of operation. The Panama Canal was traversed to explore the Caribbean coastal areas of Panama, Colombia, Venezuela, and the Guianas, as far east as Trinidad and Tobago islands. On the return to Balboa, the *Velero III* was headed homeward along the mainland coast, collecting by the way as far north as Isabel Island, Mexico.

In 1940, January 17 to February 20, the Gulf of California was the center of attraction for the third time. On the way south stops were made at Turtle Bay, Santa Maria Bay, and Magdalena Bay, and on the way back at San Benito Islands. The Gulf itself was traversed pretty well from end to end, and many points on both sides of the Gulf, as well as the shores of many of the islands in the Gulf, provided collecting stations. (Expedition Chart 9)

In 1941 no long voyage south materialized. The longest trip (February 22 to March 2), although lasting but nine days, was quite successful. The route was to Wilson Cove, San Clemente Island, Johnsons Landing and White Cove, Santa Catalina Island, south and west of Point Loma, Todos Santos Bay, Ranger Bank, San Benito Islands, South Bay, Cedros Island, around Natividad Island, north through Dewey Channel, to the northeast point of Cedros Island and home. Its principal importance lay in the fact that the gaps in the Cedros Island region were filled up to some extent in an area that is much in the limelight in discussing distribution along the west coast of Lower California in relation to other areas farther north and south. (Expedition Chart 10)

During the intervals between the longer cruises, especially in the last three years, shorter collecting trips, lasting from one day to four or five days, have been made in the area between Point Conception and Point Loma. The shore has been explored, biologically, at most of the suitable locations on the mainland as well as on the islands of the Santa Barbara

and the Santa Catalina groups of the Channel Islands. Dredging has been done at various stations off all these shores, in shallow water from the dredge boat and, farther out, in deeper water, from the *Velero III*. The beam trawl and the tangles have been used to some extent. More recently the tangles have been used with the dredge regularly when the larger dredge is used. Water samples and bottom samples have been taken frequently and, more recently, bottom cores.

While, in a later part of this volume, a list of the collecting stations, with contributing data, will be given in chronological order, a brief description of each more general location, given in geographical order, will serve to give definition to these locations in larger sections of the coastal area. (See vol 1, no. 3, for station lists.)

AN ACCOUNT OF COLLECTING STATIONS

California South of San Francisco

Plates 17, 26-28; Charts 19, 20, 25, 26

The most northerly location, represented by one dredging station, listed in the Pacific, is situated in the Gulf of the Farallones, 6 miles from the Middle Farallon and much the same distance from the North Farallon.

The Gulf of the Farallones serves as the approach to San Francisco Bay. It is bounded on the north by Point Reyes, on the south by Point San Pedro, and on the west by the Farallones. It is comparatively shallow, seldom exceeding 40 fathoms in depth, and most of it less than 30 fathoms. In general, the bottom is sandy.

The Farallones consist of three rocky islets, or groups of islets—the Southeast, the Middle, and the North Farallon islands—extending 7 miles in a northwest-southeast direction, approximately 25 miles from the Golden Gate.

Six miles south of Point San Pedro is Pillar Point, which serves to protect Halfmoon Bay from the northwest. This bay is shallow and has no protection from the southwest. There is one dredging station $1\frac{1}{4}$ miles south of Pillar Point, in 16 fathoms, coarse gravel.

Forty miles southeast of Halfmoon Bay is the much larger Monterey Bay, with a 20-mile face between Point Santa Cruz to the north and Point Pinos to the south. The shore consists largely of sand dunes, and the water is shallow for some distance out from the head of the bay with exception of a portion centrally placed where a deep canyon, Monterey Canyon, extends outward across the bay into the open ocean, with a depth, at the entrance of the bay, of 550 fathoms.

There is one station in quite shallow water at the head of the bay near the mouth of the Salinas River, in sand, and 3 stations in and outside the bay near Point Pinos, in 26-54 fathoms, shell and rock.

From Point Pinos the coast extends southwesterly 4 miles to Cypress Point and then turns abruptly eastward a couple of miles to Pescadero Point, which forms the northwestern boundary of Carmel Bay. Point Lobos appears at the southern extremity. Some dredging has been done in and around Carmel Bay in depths up to 40 fathoms.

From Carmel Bay there is a stretch of rugged coast southward 90 miles before the next station appears at Point San Luis, the point that bounds San Luis Obispo Bay to the westward. Around this rocky point,

off Port San Luis, lobster traps have been set and crabs (*Cancer*) obtained. A dredging station is located in San Luis Obispo Bay in 8-14 fathoms.

Thirty-six miles south of Point San Luis lies Point Arguello, with a dredging station a mile offshore in 15-30 fathoms.

At Point Conception, 12 miles farther on, the shore takes a sharp turn to run almost exactly east. Santa Barbara is located 40 miles from this point; and off the city, in 35 fathoms, there is a dredging station.

For 30 miles southeast of Santa Barbara there is a concavity in the coast line reaching to Point Hueneme, and then a nearly direct coast line, 23 miles, to Point Dume. Extending southward from Point Hueneme is the Hueneme Canyon. Two miles west of the mouth of this canyon is a dredging station; another is located 5 miles to the northwest of this; and still another, east of the canyon and quite close to it.

Seven miles along the coast from Point Hueneme is another canyon, Mugu Canyon, not so narrow or so definite as Hueneme Canyon. There are one dredging station near shore to the east of the canyon and two more about 4 miles offshore.

Northern Channel Islands

Plates 18-21; Charts 21-24

Separated from the eastern trend of the coast line from Point Conception by Santa Barbara Channel, and running east and west along the 34th parallel, is a series of four islands, Anacapa, Santa Cruz, Santa Rosa, and San Miguel, that makes up the Santa Barbara Islands, or the Northern Channel group.

The surface of each of these islands is irregular, and the shores are rocky, often precipitous. For much of the year there are strong winds and varying currents, from which the small open bays or coves give little shelter. There is scant precipitation, and permanent streams are scarce; hence, the vegetation, although varied, appears rather insignificant. San Miguel comes the nearest to absolute barrenness.

Anacapa Island, the most easterly, really consists of three islands—East, Middle, and West. It is 4 miles long, east to west, but in some places is quite narrow. The West Island is the highest, 930 feet.

The inshore water is rocky with kelp in places, the increase in depth is quite gradual, and the bottom soon becomes rocky or sandy, with shell.

The only shore stations are located at the east end of the West Island, or near the passage between the Middle and West islands. There are

numerous dredging stations all around the island, out to distances of $2\frac{1}{2}$ to 3 miles, in depths of 50 fathoms or less. Those north of the West Island and west of this island in Anacapa Passage are among the richest in the southern California area.

Santa Cruz Island, separated from Anacapa Island by the 4-mile Anacapa Passage, is the largest island, 21 miles long and an average of 5 miles wide. It has several harbors, coves, and anchorages, but scarcely one of them is well protected in all weathers. On the north side there are Scorpion Anchorage, near the east end, and Chinese Harbor, Prisoners Harbor, and Pelican Bay, near the center—all in one large bight. To the east there are Smugglers Cove and to the south Willows Anchorage. The only island offshore, and it is small, is Gull Island, near the west end of the south side.

There are shore stations at Scorpion Anchorage and at Willows, where there are reefs and some turnable rocks, and at Prisoners Cove and Pelican Bay. There are dredging stations all around the island, but they are rather scarce along the east half of the south side and the west half of the north side. The latter area does not promise much, but the former gives indication of some good material. The dredging depths have ranged from 6 to 140 fathoms. The change in bottom with depth is much the same as with Anacapa.

Santa Rosa Island, 5 miles across Santa Cruz Channel from Santa Cruz Island, 15 miles long and 10 miles in greatest breadth, has almost as great an area as Santa Cruz Island. Water is more plentiful, and hence the vegetation is more conspicuous. The shore line is little indented, Bechers Bay, to the northeast, being the only inlet of any size. There are no islands off the coast, but offshore rocks are so numerous that few spots offer a good landing even in fair weather.

There are a fair number of dredging stations off Bechers Bay, on south through Santa Cruz Channel and to the southeast of the island, but the remainder has not been touched. This latter part is foul with rocks, reefs, and kelp in shallow water, but is better farther out. To explore it thoroughly, better sea and weather conditions than are commonly met with are necessary. The shelf south of the island, extending 18 miles from shore, should receive, and probably will receive, much more attention, as the dredging there, so far, has been very fruitful.

San Miguel Island, the most westerly of the group, is separated from Santa Rosa Island by the 3-mile San Miguel Passage. It is $7\frac{1}{2}$ miles long, with an average width of 2 miles. The island is pretty well covered with

grasses, but there are no trees. There are more outlying rocks and reefs off the coast here than there are in the vicinity of the other islands, but there are some reasonably well-protected bays and harbors, although none of them is safe in all weathers. Cuyler Harbor on the north coast is the largest.

Shore collecting has been done only at the west end of the island, just north of Point Bennett. Dredging has been done in San Miguel Passage and at several points along the south coast, mostly in shallow water; but some deeper hauls have been made south of the west end of the island. On the north side the only dredging has been in and north of Cuyler Harbor.

Southern Channel Islands

Plates 22-25; Charts 27-31

The whole Santa Barbara Islands region, at least in waters 50 fathoms or less, offers greater inducements to carry on intensive work than does any other area of similar size that has been explored between Point Conception and the Mexican boundary. There are many places in which the fauna is rich and varied. In the deeper water farther out the bottom is nearly always fine sand or mud with very little to show as compared with the shallower water.

The eastern terminus of Santa Barbara Channel is Point Dume, 28 miles directly east of Anacapa Island. It also serves as the western or northwestern limit of Santa Monica Bay, which stretches 25 miles across to Cape Vicente. The shore of the bay forms a regular curve, and there is nowhere in it suitable protection in stormy weather. In general, the depth increases gradually from shore, but near Redondo there is a submarine valley with deep water almost to the shore, Redondo Canyon. At both extremities of the bay the shore is rocky and somewhat rugged, although in places the banks are clay; but the intervening portion, in the main, is a sandy beach, although it may be backed by rocky or clay cliffs.

Shore collecting has been done on an old pier at Playa del Rey and on the rocks at Bluff Cove, some distance south of Redondo Beach. Most of the dredging and beam trawl stations have been grouped in or near the Redondo submarine canyon, but there are two a short distance off Manhattan Beach.

At Point Vicente the coast line turns abruptly to run a little south of east for 7 miles to Point Fermin, the western limit of San Pedro Bay. The shore here is abrupt and rocky. Around Point Fermin and at Portu-

guese Bend, 2 miles east of Point Vicente, conditions are favorable for collecting at low spring tides, and some of it has been done at both places. There are dredging stations a short distance out from both of these points.

Point Fermin forms the western boundary of San Pedro Bay, which, with San Pedro Harbor, has become Los Angeles Harbor, with extensive sea walls or breakwaters to provide protection in all weathers. The outer breakwater, especially that part of it toward Point Fermin, has developed a rich fauna to be reached by low-tide collecting. In the harbor itself the hull of *Velero III* in dry dock at Craig's served as a collecting station. Anaheim Slough, near Seal Beach, was at one time a fine collecting area, but the changes that have been made in developing the area have destroyed much of the fauna. Dredging stations extend out from Seal Beach and Sunset Beach as far as the entrance of Los Angeles Harbor.

From Los Angeles Harbor the shore extends 70 miles in a gentle curve to Point La Jolla. It is low and sandy throughout, along the shore and for some distance out from shore, with few rocky projections and with no indentations that can be called bays, with the exception of the small, shallow Newport Harbor. The sandy bottom shore area is rather definitely marked off from the area farther from shore, and the increase in depth from this line is rapid.

Certain of the rocky projections at Corona del Mar, Laguna, and La Jolla have served for shore collecting. A series of dredging stations extend for 10 or 12 miles from Huntington Beach, Newport, and Laguna Beach. A bank that comes to about 60 fathoms from the surface midway between Dana Point and the eastern end of Santa Catalina Island has received considerable attention with both dredge and tangles.

From Point La Jolla the shore extends southward, 11 miles, to Point Loma, the western boundary of San Diego Bay. No collecting has been done in this stretch except for some shore work in Mission Bay, about midway between the two points. It is much in the nature of a large lagoon, and the fauna seems to be going the same way as it is in Anaheim Slough.

Lying some distance off the shore that extends from Point Vicente to Point Loma are the four islands that make up the Santa Catalina group, or the Southern Channel Islands. They do not form a linear series as the Santa Barbara Islands do, and no two of them are near each other. The main axis of each extends in a northwest-southeast direction. In general

appearance and in vegetation there is much general resemblance to the Santa Barbara Islands.

Santa Catalina is the largest of these islands, and it lies nearest the mainland, 18 miles across the San Pedro Channel from Point Fermin. It is 18½ miles long with a greatest width of 7 miles. Six miles from the northwest end it is almost divided into two parts by Catalina Harbor on the southwest coast and Isthmus Cove on the northeast; the low isthmus is only half a mile across. There are two inhabited areas both on the east coast, the one at Isthmus Cove and the other at Avalon (Dakin Cove), near the southeast end of the island, with smaller settlements at other points. The shore is rugged and even precipitous in places, with few beaches, and these small.

It affords so few satisfactory locations for shore collecting that very little has been done. The only shore collecting station is in Fourth of July Cove, on the north side of Isthmus Cove. The seaward slope is steep, so that there is little shallow water out from the coast. To the west and southwest there are strong currents and little shelter from the strong winds. It is but a short distance out to muddy bottom, and the stations in this bottom give little but polychaetes, brittle stars, and sea cucumbers.

All of the remainder of the way around the coast of the island dredging has been extensive, from close in shore to as much as 6 miles out. One bank, 6 miles east of Long Point with a loose rock bottom in 225-230 fathoms, is particularly rich in echinoderms. The favored locations have been off the northwest end of the island, off Emerald Cove, off Isthmus Cove, off Long Point and White Cove, off Avalon, and off the southeast end of the island.

In the deeper parts of San Pedro Channel, as well as in the other wide channels, except on certain small banks, the bottom is of green mud, but in shallower water this often gives way to sand, sometimes with shell or coralline, and then to rock, although there are rock patches well scattered over the whole area. Gravel patches or pebble beds seem to be conspicuous by their absence.

Lying 21 miles to the westward of the northwest end of Santa Catalina Island is Santa Barbara Island, the smallest of the four. It is only 1½ miles by 1 mile. There is a wider shallow-water area around this island, which area is rocky and heavily provided with kelp. Off the southwest end of the island the area is particularly foul with rocks and reefs. A rocky island—Sutil or Gull Island—lies 200 yards offshore, the channel foul and shallow. The islet is 300 feet high and is quite conspicuous. There is no very safe anchorage.

A small amount of shore collecting has been done around the north end of the island. Dredging stations appear all around the island and out to banks 15 miles to the northward and 6 miles to the southward (Osborn Bank). Beam trawling has been done all along the east side.

Twenty-four miles southwest of Santa Barbara Island is San Nicolas Island, 8 miles long, with an average width of 3 miles. There is more sandy beach on this island than on any of the others; but even off the beaches a short distance rocky patches appear, close or scattered, to give holdfast to a very abundant supply of kelp. At the west end this extends out from shore for as much as three miles.

A small amount of shore collecting has been done at Dutch Harbor on the south coast, the only place around the island that offers even a modicum of shelter. Scattered dredging stations appear north and northwest of the eastern end of the island and in a more concentrated area on the south coast, off Dutch Harbor.

San Clemente Island is the southernmost of the group, directly south of Santa Catalina Island, 19 miles away, and 60 miles from the mainland coast at La Jolla. It is almost as long as Santa Catalina Island, but it has an average width of only $2\frac{1}{2}$ miles. The northwest half of the island has much more regular surface than is ordinarily found in these islands, but the remainder of the island is more corrugated. The northeast side is rocky and abrupt, but the southwest side is much less so, the sea slope here being correspondingly more gradual. There is much less kelp around the shores than around San Nicolas or Santa Barbara. There are three harbors near the north end—West Cove, Northwest Harbor, and Wilson Cove—and Pyramid Cove at the south end.

Shore collecting has been done at Northwest Harbor, Pyramid Cove, and Horse Cove (adjacent to Pyramid Cove). Dredging has been done west, north, and east of the north end of the island, in and near Wilson Cove, and in and off Pyramid Cove.

Lying southwest of San Clemente Island, the nearest one 30 miles away, are three large banks and other smaller ones, the surface of which comes much nearer to sea level than that of the surrounding areas. They all have their long axes in a southeast-northwest direction and are much longer than they are broad. They may be considered as South Channel Islands that do not quite reach the surface.

The largest of these banks is Cortes Bank, which, measured within the 100-fathom line, is 25 miles long and 8 miles broad. Within the 50-fathom line it is 19 miles long, with a greatest width of 5 miles, and

within the 20-fathom line it is 3 miles long and $1\frac{1}{2}$ miles wide. The pinnacle, Bishop Rock, is but 15 feet below the surface. Chart 32.

This bank lies 36 miles off San Clemente Island and is the most southerly bank of the group.

Tanner Bank, lying 5 miles northeast of the northern part of Cortes Bank, is not so large, $12\frac{1}{2}$ miles long, $5\frac{1}{2}$ miles wide. The pinnacle has 12 fathoms of water over it. Charts 32, 33.

Directly in line with Tanner Bank, 9 miles to the northwest of it, is the third large bank, yet unnamed, 9 miles long and 3 miles wide. It is 17 miles south of San Nicolas Island. No part of it comes nearer to the surface than 50 fathoms.

Dredging has been done on each of these banks with fair success. Much of the bottom is rocky, but there is also a large amount of sand and finely broken shell. In some spots there is coralline.

Point Loma is a narrow point of land extending directly southward to shut off San Diego Bay from the open ocean. The mainland shore extends in a regular, wide curve to the International Boundary, 10 miles from Point Loma. San Diego Bay itself, 7 miles long, is shut off further by a narrow spit that extends northwestward from the main shore, some distance south of the city of San Diego. This leaves a shallow bay, mostly with sandy bottom, outside the spit, extending southward from Point Loma to beyond the International Boundary. Chart 34.

The beam trawl and the small dredge have been used here in water less than 10 fathoms, while dredging from the *Velero III* has been done farther out, and in deeper water, about 80 fathoms, on a bank that lies 8 or 9 miles off Point Loma.

Lower California—West Coast

Plates 29-36; Charts 35-39, 41-45

When the coast line crosses the boundary, it is trending directly southward, and it continues much in this direction for 17 miles to Point Descanso. At first much of the shore is sandy, but later bluffs up to 80 feet in height appear, with characteristic flat-topped hills in the background, Table Mountain being very distinctive. The shallow water bench extends outward from shore from 8 to 12 miles, but from this to deep water the change is quite abrupt.

On this shallow water bench, 7 miles from shore and 5 miles south of the boundary, are the Coronado Islands, with a southeasterly axis. North Coronado is about one mile long, Middle Coronado consists of two small

islets, and South Coronado is $1\frac{3}{4}$ miles long. They are all precipitous and rugged, the north island 467 feet high and the south island 672 feet. For most of the year they appear very barren, but in the early spring (February and March) flowers may be quite abundant.

There is a dredging station in 14 fathoms between South Coronado and the main shore.

From Descanso Point to San Miguel Point, 26 miles, the shore takes two steps, first east and then south. There are several sandy beaches, but they are backed by abruptly rising bluffs or hills, and often the shore itself forms a bluff. There is little protection in any part of this coast. The depths increase rapidly offshore so that the shelf is narrow.

San Miguel Point forms the northern boundary of Todos Santos Bay, which provides the best protection along a great stretch of the northern part of the west coast of Lower California. The town of Ensenada is situated near the head of the bay. The bay, somewhat rectangular, is 9 miles wide at the entrance between San Miguel Point and Banda Point. Lying off the latter point 3 miles are the Todos Santos Islands, which offer some protection to the waters of the bay. A wind from the northwest is interrupted very little. The bay is all relatively shallow except for a small area north of Banda Point. An extensive lagoon lies behind a low sand beach on the south shore. Much of the bottom is sand or mud, but there are several rocky patches. Two dredging stations are located about 3 miles off San Miguel Point at the entrance to the bay.

From Point Banda to Cape San Quentin, a distance of 90 miles, the coast is quite regular, made up of three shallow bights, the northern one small, from Point Banda to Santo Tomas Point, the other two much more extensive—the first one from Santo Tomas Point to Cape Colnett and the second from this cape to Cape San Quentin. The coast is a succession of sandy beaches, rugged patches with outlying kelp, and more or less abrupt bluffs, with the background, hills, nearer the shore in the northern portion than in the southern. The most conspicuous feature is Cape Colnett, a semicircular headland that rises abruptly from the water in perpendicular cliffs to a plateau 300 or 400 feet high.

The shallow water shelf is much broader here, reaching a maximum width of 17 miles.

South of Cape San Quentin there is another bight extending to Point Baja, 26 miles, resembling those last mentioned except that Cape San Quentin extends southward to a long point to form the boundary of San

Quentin Bay, in which some dredging has been done in 25 fathoms or less.

From Point Baja to Point San Antonio, 12 miles, the San Quentin bight is repeated but on a smaller scale, with a bay, Rosario Bay, similarly placed to San Quentin Bay. There is an extensive sandy beach; and outside it, the bay, and the whole bight, for that matter, is well filled with kelp. A couple of miles off Point Baja there is a gap in the kelp, and here there is fair anchorage. Three dredging stations are located at the entrance to this gap.

From Point San Antonio to Point San Rosarito, a distance of approximately 110 miles, the coast line extends southeasterly. It consists of a series of shallow bights, varying much in breadth. In most cases the point between the bights extends in a southerly direction, to give slight protection to the northern extension of the bight, which in some cases is even called a bay. The last of these, Santa Rosalia, 7 miles across the entrance, deserves the name better than the others. The shore, in general, is of much the same type as that farther north. The depth of the water increases gradually, so that the 100-fathom line may be 30 miles or more offshore.

From Point San Rosarito, the coast line makes a long, gradual sweep southward, then southwestward, and finally westward to Cape San Eugenio. This large area, extending from Maria Point, 30 miles northwest of Point San Rosarito, to Cape San Eugenio and bounded on the west by Cedros Island, is Sebastian Viscaino Bay. It is 60 miles from Maria Point to Cape San Eugenio and 48 miles from Maria Point to the north end of Cedros Island. The whole bay is shallow, with no soundings greater than 70 fathoms recorded.

From Point San Rosarito almost to Cape San Eugenio the coastal area is low and much of the shore is sandy beach. Close to the shore and opening into the bay are three extensive lagoons, Manuela, Black Warrior, and Scammon. North of the entrance to Manuela Lagoon is a prominent headland, Lagoon Head (Morro de Santo Domingo), serving as a protection to Lagoon Head Anchorage.

Toward Cape San Eugenio the coast becomes more rugged again, particularly so in the vicinity of False Point, 12 miles northwest of Cape San Eugenio.

Apart from the collecting near Cedros Island, mentioned later, the only stations are in and off Lagoon Head Anchorage and in Manuela Lagoon.

Islands Off the West Coast of Lower California

Plates 29-32; Charts 39, 40

Off the west coast of Lower California, from Todos Santos Bay to Cape San Eugenio, there are several islands of special interest.

Guadalupe Island (North Point $29^{\circ} 11'$ North, $118^{\circ} 17'$ West), lying about 140 miles off the coast and 150 miles west and slightly north of the San Benito Islands, is 20 miles long, north and south, with a maximum width of 7 miles. Off the south end are two islets, the Inner Islet and the Outer Islet, the latter being 677 feet high. It is of volcanic origin and is mountainous (highest peak near North Point, 4,500 feet). The shores are so bold and rocky that landing is possible only in very limited areas. The south of the island is quite barren, but in the northern part there are fertile valleys, and there is some vegetation on the mountains. This vegetation has suffered badly from the numerous goats on the island. The depth of the water offshore increases rapidly, so that there is little or no shelf.

Guadalupe Island is of particular interest as the home of elephant seals and sea lions, and fur seals have also been reported. The island has been visited mainly to obtain live elephant seals for the San Diego Zoological Gardens, but some shore and inland collecting has been done.

The largest island off this part of the coast is Cedros (Cerros) Island, lying 12 miles to the northwest of Cape San Eugenio and forming the western boundary of Sebastian Viscaïno Bay. It is $20\frac{1}{2}$ miles long, from north to south, and from 2 to 9 miles wide, the widest portion being near the south end. The surface is very rugged, with high, abrupt peaks (the highest, Cedros Mountain, 3,950 feet), with deep, irregular valleys between. The southern end of the island is perhaps the most barren area along this whole barren coast. Toward the north end there are vegetation and even trees—cedars, pines, and some dwarf oaks.

The island arises from the continental shelf, so that there is shallow water for a considerable distance on all sides. Dredging and shore and inland collecting have been done on the east side near the north end and in or near a small village not far from the south end. In South Bay, to the south of the island, shore collecting has been done and dredging near the reef and kelp bed that extends outward from Cape San Agustín, the southwest point of the island.

Lying to the westward of the northern portion of Cedros Island, $14\frac{1}{2}$ miles, are the three San Benito Islands, East, Middle, and West. They are all rocky and barren, and there are outlying rocks and masses of kelp

in almost every direction. The West Island is the largest and highest (661 feet), the East Island is the second, and the Middle Island is a small, low, flat island. The passage between the East and Middle islands is safe for navigation, but the other passage is not.

A spur of the continental shelf extends northward from the area west of Cape San Agustin, Cedros Island, to surround the San Benito, but there is a tongue of deeper water coming in from the north that separates these islands from the northern portion of Cedros Island.

At present the San Benito Islands serve as the home of many sea lions and elephant seals. At one time, the elephant seals were slaughtered so extensively that, as far as the San Benito were concerned, they seemed to be exterminated, but a few remained on Guadalupe Island; and, when they were totally protected for some time, the numbers materially increased, and now they are back on San Benito Islands again in goodly numbers.

Some collecting has been done on all the islands, and considerable dredging to the south of them.

Lying 6 miles to the northward of East San Benito Island, Ranger Bank extends on northward for 11 miles, with a breadth of $1\frac{1}{4}$ to $3\frac{1}{2}$ miles. It is at quite a uniform depth of 67 to 75 fathoms, except at the margins where the depth is slightly greater, and is surrounded by water of much greater depth. The bottom consists of rock in place, loose rock, pebbles, and shell, with an abundance of a tall, much-branching coral. Dredging here has given very satisfactory results.

Natividad Island lies $3\frac{3}{4}$ miles west of Cape San Eugenio, separated from it by Dewey Channel. It lies in a northwest-southeast direction, $3\frac{3}{4}$ miles long, $\frac{1}{2}$ to $1\frac{1}{2}$ miles wide. It is barren and hilly and is surrounded by reefs, rocks, and kelp patches that extend into Dewey Channel, but there is a safe passage through, near the mainland shore.

Dredging has been done in Dewey Channel and in various directions from Natividad Island, in depths of 20-65 fathoms.

The whole area west and south of Cedros Island, from Ranger Bank, past the San Benito Islands, to and around Natividad Island, on the continental shelf, has been explored to some extent, with very satisfactory results. Much of the bottom is shell, coral, nullipores, and sponges, on a rocky or sandy base, and the fauna is rich in practically all groups of marine invertebrates. It is of special interest because this area appears to be the northern portion of a zone that extends southward to Santa Maria Bay, or Magdalena Bay, where there is much distributional overlapping between the Panamic and Californian faunas.

For 10 miles southward from Cape San Eugenio, the coast is somewhat abrupt, but little indented, backed by rapidly rising hills. For the next 5 or 6 miles to Kelp Point it forms a shallow bight with a low-lying shore, but Kelp Point itself is more conspicuous. It forms the boundary for Port San Bartholomé, with a southern extension to form Turtle Bay, which provides the best harbor between the International Boundary and Magdalena Bay. It is 1 mile wide at the entrance and has a depth of $2\frac{1}{2}$ miles. Most of the shore is formed by gravel, shingle, or sand beaches. Cape Tortolo forms the southwestern limit of the bay. From this cape, for over 2 miles to Thurloe Head there is a continuous, conspicuous cliff, 25 to 100 feet high. A reef extends from Thurloe Head in a southerly direction for 400 yards, around and adjacent to which is the most southerly mass of kelp, similar in nature and size to the kelp beds farther north. South of this point, these large kelps gradually disappear, until no more of them are in evidence.

East of Thurloe Head is Thurloe Bay, with a sand or shingle beach backed by sand hills.

Shore collecting and dredging have been done in the vicinity of Port San Bartholomé, Thurloe Head, and Thurloe Bay. Dredging near the kelp on the reef off Thurloe Head gave excellent results.

From Thurloe Head to Abrejos Point, a distance of nearly 100 miles, the coastal area is quite inconspicuous. The coast line itself forms a number of wide, shallow bights. In the northern portion bluffs appear along the coast, but these soon disappear, and the shore is mostly low lying, sandy, with several extensive lagoons just behind it. The 100-fathom line may be as much as 20 miles offshore. The only stop that has been made in all this distance was off Asunción Island, near the center of the coast.

From Abrejos Point the coast makes a wide sweep, first southeastward and then almost directly southward to Cape San Lazaro, 135 miles away, in a straight line, with only two significant indentations, Ballenas Bay, behind Point Abrejos, and San Juanico Bay, over a third of the way southward. From the sea this coastal area is not interesting. Most of it is low, with sandy shores and extensive lagoons, with sand dunes or low benches, sometimes cut with arroyos, forming the immediate background. Hills or mountains can commonly be seen, but they are far in the distance. The seaward slope is just as gradual; the 100-fathom line may be 40 miles offshore. The bottom is sand, mud, and broken shell.

The only collecting stations along this part of the coast are in San Juanico Bay, but in one stormy passage southward several specimens were

picked up on deck, about 50 miles offshore, slightly south of San Juanico Bay.

From Cape San Lazaro the coast trends southeastward for $3\frac{1}{2}$ miles to Hughes Point, the northwest boundary of Santa Maria Bay, with an entrance width of $7\frac{1}{2}$ miles, to Cape Corso, its southwest boundary. From this entrance, the bay extends $4\frac{1}{2}$ miles to the northeastward. A narrow strip of sand beach serves as its east coast and separates the bay from Magdalena Bay.

Cape Corso is the northern extremity of a narrow peninsula that extends to the southeast 9 miles to Entrada Point, to separate all but the southern portion of Magdalena Bay from the open ocean. Its open coast consists of a series of rocky points separated by sandy beaches. The southern portion of this bay and its southern extension through Marcy Channel, Almejas Bay, are separated from the open sea by the large island, Santa Margarita, 21 miles long and as much as $4\frac{1}{2}$ miles wide. It is bold and rocky at each end but low and sandy in the central portion. The northwestern tip is Redondo Point, and the southeastern is Point Tosco.

Although the entrance to Magdalena Bay, from Entrada Point to Redondo Point, is only 3 miles wide, the bay is large, 17 miles by 12 miles. Most of the coast is low and sandy, with numerous lagoons, shoals, and sandbars. This is true of Almejas Bay as well.

Considerable dredging and shore collecting have been done in and off Santa Maria Bay, particularly in the vicinity of Hughes Point. There are one dredging station 8 miles off the entrance to Magdalena Bay in 81 fathoms and two off Point Tosco in 15 and in 45 fathoms.

From Point Tosco to Cabo Falso, the southern extremity of Lower California, approximately 130 miles, the coast line is regular with no significant indentations. Most of the minute dents appear where the arroyos meet the sea. For the first hundred miles the coast and the immediate background are low, rather frequently cut with arroyos. At Lobos Point, near-by low hills begin to appear and the sand beaches are broken by rocky or sandy bluffs; this condition is continued to Cabo Falso. In this area also there are distinctive arroyos. The shelf out to the 100-fathom line continues wide until within 50 miles from the extremity of the peninsula and then abruptly contracts to 1 to 3 miles.

There has been little collecting in all of this vast area, but directly west of Cabo Falso, 14 miles, rising from the deeper water to a minimum depth of 50 fathoms and consisting of 3 patches, is the area known as San Jaime Bank, which has been explored to some extent.

From this account it is evident that the Pacific Coast of Lower California, with the exception of the Cedros Island region, has been explored very inadequately as yet, although it is an area of promise above the average. It is quite a different story with the east coast of the peninsula and the whole of the Gulf of California.

Before giving consideration to this large and important area, some reference may be made to some of the outlying islands.

The Revilla Gigedo Islands

Plates 74, 75; Charts 46, 47

South of Cabo Falso 260 miles and slightly west of it is Socorro Island, the largest island of the Revilla Gigedo group. This island consists of a large volcanic cone, Mount Evermann, 3,707 feet high, with several smaller cones, some of them quite small, on its flanks. It is 10 miles in length and over 8 in breadth. The slopes to the north and west are quite steep, to the south and east much less so. The whole island is volcanic, and the general appearance, due to exposed lava and a general lack of green vegetation, is anything but inviting. There is said to be fresh water on the island throughout the year, but there is not much general evidence of it. At times the island has been inhabited. Chart 46.

Some of the ash or cinder cones stand out prominently; the one to the westward of Braithwaite Bay is a characteristic feature of the island. In many cases the lava flows are entirely exposed. Near the shore this is generally true, but in the gullies or draws, or even on the regular slopes, the cactus and low shrubbery may be plentiful, often so thickly matted that passage through is not readily possible.

The island is nearly rectangular, the northern portion terminating in Cape Middleton, the eastern in Cape Pearce, the southern in Cape Rule, and the western in two points, two miles apart, Rugged Point and Cape Henslow. A short distance off this latter cape is a conspicuous, rocky islet, Oneal Rock. The shore, in general, is abrupt and rugged, with plenty of outlying rocks, but with deep water close offshore; hence, there are few spots that offer a good landing. Much of the southwest coast consists of a narrow bight, Cornwallis Bay; and on the south shore, some distance east of Cape Rule, is the only real bay on the whole coast, Braithwaite Bay, with the cinder cone, mentioned above, forming much of its western boundary. At the head of the bay is a beach, well supplied with isolated rocks, so that it may be described as bouldery rather than shingly.

There is plenty of evidence that Socorro is a tropical island. Frigate birds, goonies, and boobies fly about, mantas and sharks are abundant in

the waters, the brilliant red Sally Lightfoot crab scuttles about among the boulders on the beach, and coral masses appear at or near the surface.

With the exception of some shore collecting at Grayson Cove, in the northwestern part of Cornwallis Bay, all the stations are in the vicinity of Braithwaite Bay and Cape Rule. The bouldery shore provides much good material, and the coral masses protect an interesting association of species. Dredging in depths to 75 fathoms, mostly in nullipore bottom, has been profitable but not startlingly so.

Clarion, the only other sizable island in the group (San Benedicto Island, very small, and Roca Partida, a rocky islet, have not been visited), lies 214 miles to the westward of Socorro Island, but separated from it by water of a depth of over 2,000 fathoms. It, also, is volcanic, and in many of its physical features it resembles Socorro. Instead of a single large cone, there are three, 1,100, 933, and 959 feet high. The island is $5\frac{1}{4}$ miles long, east and west, and 2 miles wide, rectangular or trapezoidal in shape. It is abrupt to the north, west, and east, but slopes much more gradually to the south from a high ridge running east and west. The slope flattens more toward the sea, with the area approaching the two southern beaches (the only beaches on the island) not so far from being level. There is a large dry lagoon near Sulphur Bay. Chart 47.

Instead of having distinct points at the four corners, as Socorro has, there is one rocky point to the southwest; but at or near the other corners there are conspicuous outlying rocks or rocky islets—Monument Rock to the northwest, Shag Rock, somewhat moved southward, to the northeast, and Pyramid Rock to the southeast. The only bay, and it is not very prominent, is Sulphur Bay, on the south shore, $1\frac{1}{2}$ miles east of Rocky Point.

The surface has much the same general appearance as Socorro, but there is more vegetation, even if the most of it is cactus. The fauna is similar in type to that of Socorro. The island is an important breeding place for birds.

Much shore collecting and inland collecting have been done at Sulphur Bay and around the lagoon back of it, much dredging in and off this bay, with conditions much similar to those at Braithwaite Bay; and there are four stations located north of the west end of the island.

Clipperton Island

Plate 75

Away to the southeast of the Revilla Gigedo group, 515 miles from Socorro Island, lies the isolated Clipperton Island ($10^{\circ} 17'$ North, 109°

13' West). It is 600 miles from the nearest mainland, near Cape Corrientes, Mexico, and 1,400 miles almost due west of Port Culebra, Costa Rica. Apparently, Clipperton is the only sizable atoll in the Eastern Pacific. The lagoon is a couple of miles in breadth, with a depth varying from a few inches to 55 fathoms. The low coral ring that forms the island varies in width from a few yards to a quarter of a mile, and in height, from 5 to 14 feet.

On the west side of the island there is a clump of cocoanut palms, and on the east side are some scattered palms and a conspicuous rock, Clipperton Rock, 62 feet high, which, from certain directions, looks like a sail. The island is fringed by a coral reef and coral rocks, over which there is always a surf breaking. Outside the reef the water deepens rapidly.

On the occasion of the only visit to this island, the surf was too heavy to attempt landing. Dredging was attempted to the east of the atoll, but the slope was so steep and the bottom so rocky that the attempt met with little success.

PLATE 17

- Fig. 31 The Golden Gate Bridge as seen from the flying bridge of the *Velero III*, which visited San Francisco Bay in August of 1938. The bay region is the northernmost coastal area explored by Allan Hancock Pacific Expeditions.
- Fig. 32 Rolling hills covered with live oak trees rise behind Port Luis Obispo near Avila, where *Velero III* often anchored while side trips were being made to Captain Hancock's Santa Maria properties.

PLATE 18

- Fig. 33 View of Cuyler Harbor, San Miguel Island, looking northeast. A steady wind which blows from the west has lifted sand from the windward side of the promontory and deposited it on the lee side as shown in the picture. (Photograph, L. A. Museum—Channel Islands Biol. Survey.)
- Fig. 34 View of Cuyler Harbor looking northeast from the main island of San Miguel toward Prince's Island. The *Velero III* rides at anchor at the right of the smaller islet. Chart 24, p. 379.
- Fig. 35 A rookery of California sea lions off Point Bennett, at the extreme western tip of San Miguel Island. Dangerous submerged reefs extend for several miles to the west and north.

PLATE 19

- Fig. 36 View of Santa Rosa Island looking northwest along the shore from the summit of Skunk Point. (Photographs, figs. 36-40, by Arthur Woodward.)
- Fig. 37 Sand dunes at the east end of Santa Rosa Island. Chart 23, p. 379.
- Fig. 38 Mouth of Elderberry Canyon near the wharf at Becher's Bay, Santa Rosa Island.
- Fig. 39 Skunk Point, Santa Rosa Island, site of an old Indian village.
- Fig. 40 View of Santa Rosa Island looking northwest across Becher's Bay. An old Indian village site is located on the point in the middle foreground.
- Fig. 41 View along the beach at Santa Rosa Island showing the way in which the sand has been piled in dunes by the incessant wind. (Photograph, L. A. Museum—Channel Islands Biol. Survey.)

PLATE 20

- Fig. 42 Pelican Harbor, on the northern or protected shore of Santa Cruz Island, which is sparsely covered with oak and Bishop pine. A few inhabited dwellings may be seen on the promontory in the center of the picture.
- Fig. 43 Willow's Anchorage, on the south shore of Santa Cruz Island. The Tertiary sediments of Anacapa and Santa Cruz islands represent a western extension of the Santa Monica Mountains. Chart 22, p. 378.
- Fig. 44 Prisoner's Harbor, Santa Cruz Island, showing the protected landing place in which small vessels may anchor to serve the farmhouse a short distance inshore. The perpendicular cliffed shore line is similar to that of Anacapa Island, which lies but a few miles across Anacapa Passage.

PLATE 21

- Fig. 45 East Anacapa Island, with west island visible in the middle distance and Santa Cruz Island beyond. Wave action has resulted in a remarkable series of sea stacks, seen at the base of the lighthouse. Chart 21, p. 378.
- Fig. 46 The results of wave action are clearly seen on Gull Island, a series of low rocks lying off the southwest corner of Santa Cruz Island and marked by a flashing light. Much dredging was done in the vicinity of Gull Island and in the adjacent Santa Rosa Channel.

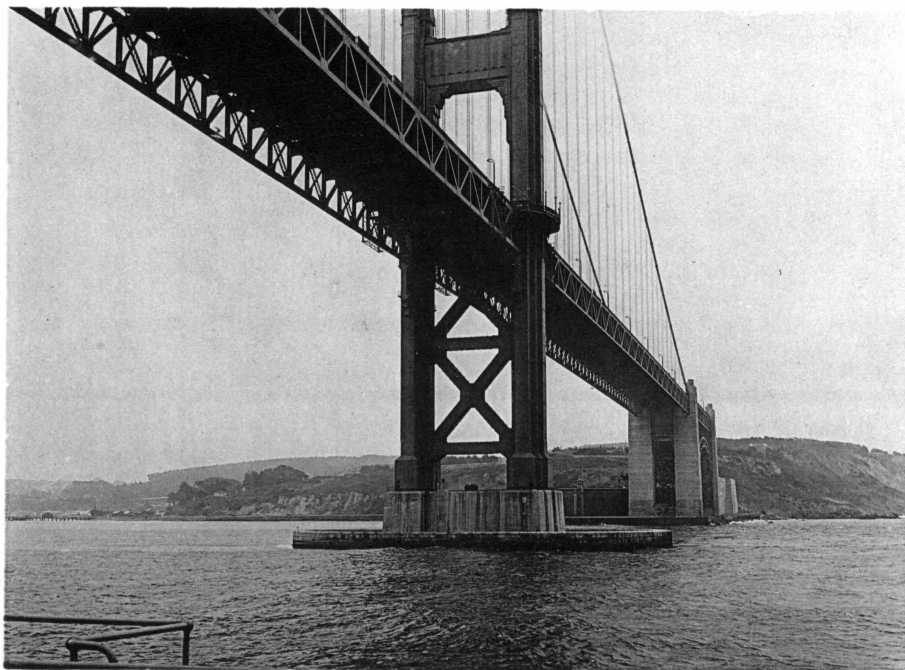
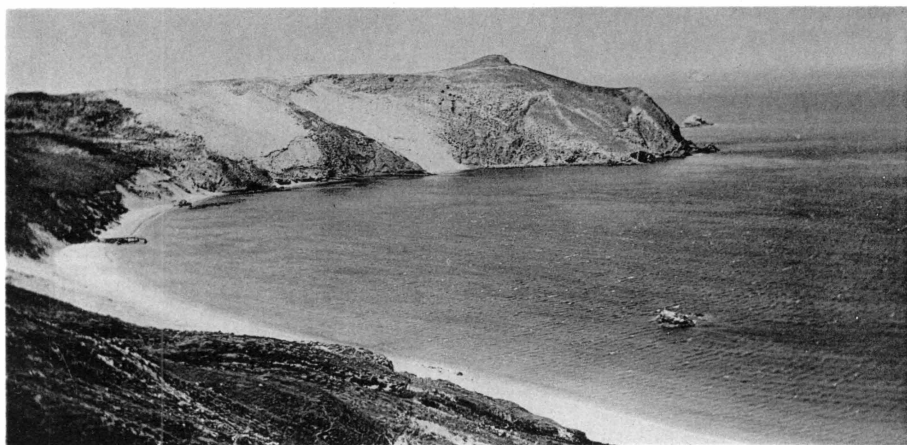


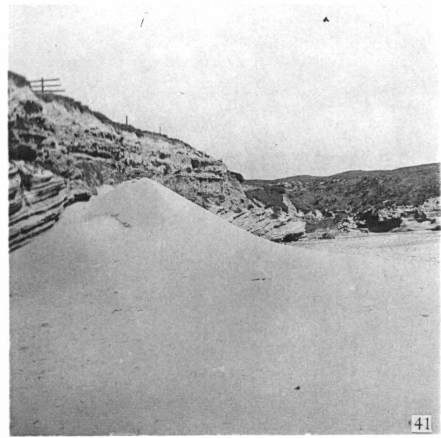
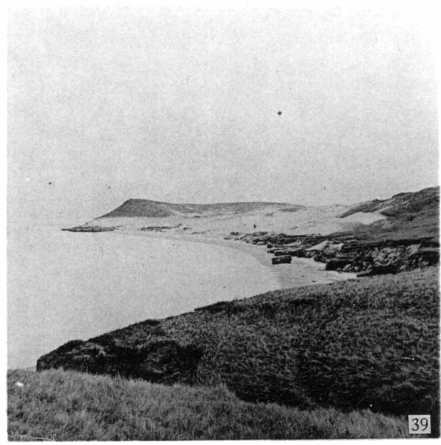
Fig. 31 *Velero III* beneath Golden Gate Bridge



Fig. 32 Port San Luis Obispo near Avila



Figs. 33, 34 Cuyler Harbor ; 35 Point Bennett, San Miguel Island



Figs. 36-41 Santa Rosa Island



Figs. 42-44 Santa Cruz Island

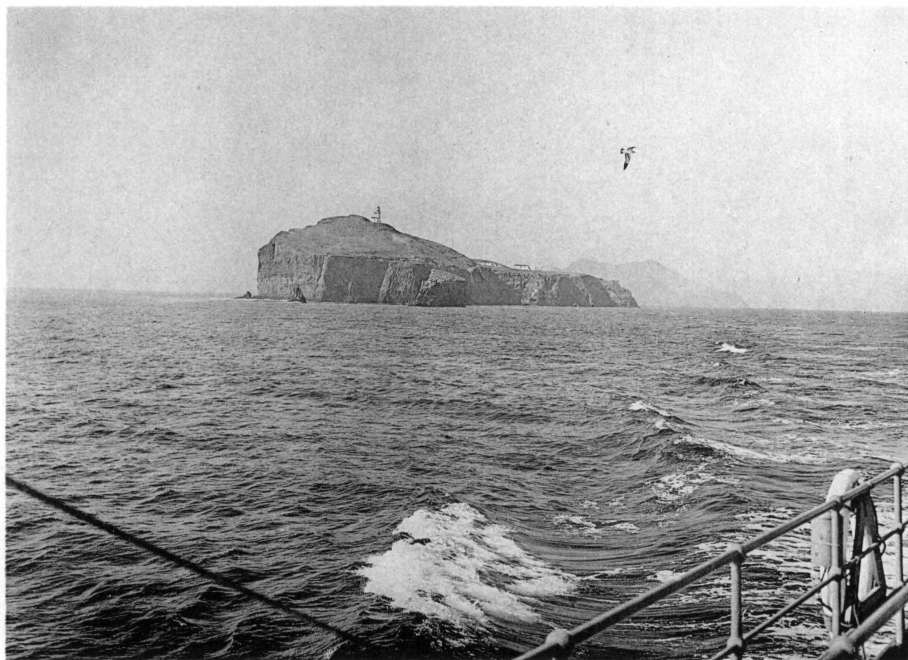


Fig. 45 East Anacapa Island



Fig. 46 Gull Island off SW corner of Santa Cruz Island

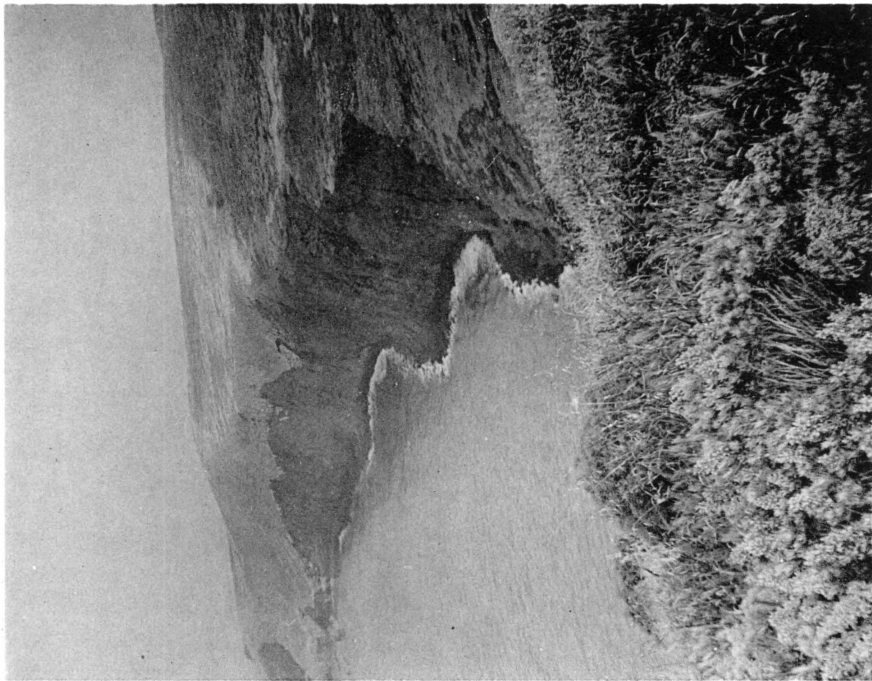


Fig. 47 Santa Barbara Island, northwest side

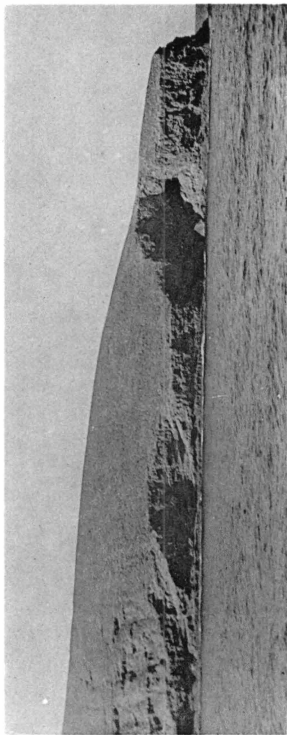


Fig. 48 Santa Barbara Island

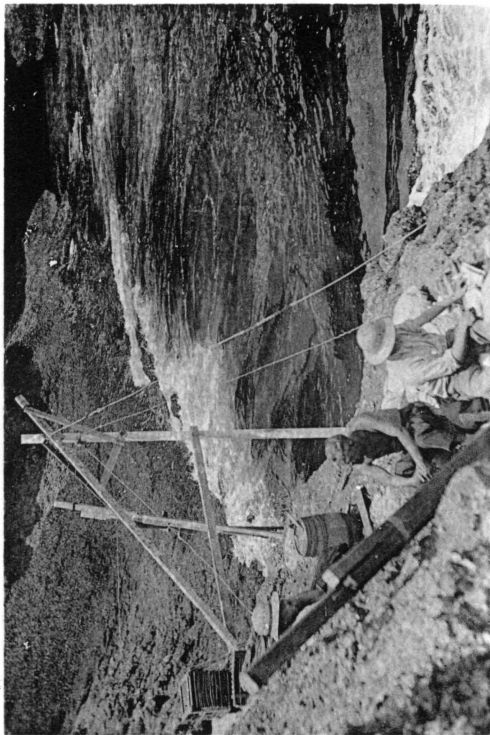


Fig. 49 Santa Barbara Island Landing



Fig. 50 San Nicolas Island, Dutch Harbor



Fig. 51 San Nicolas Island, east sand spit

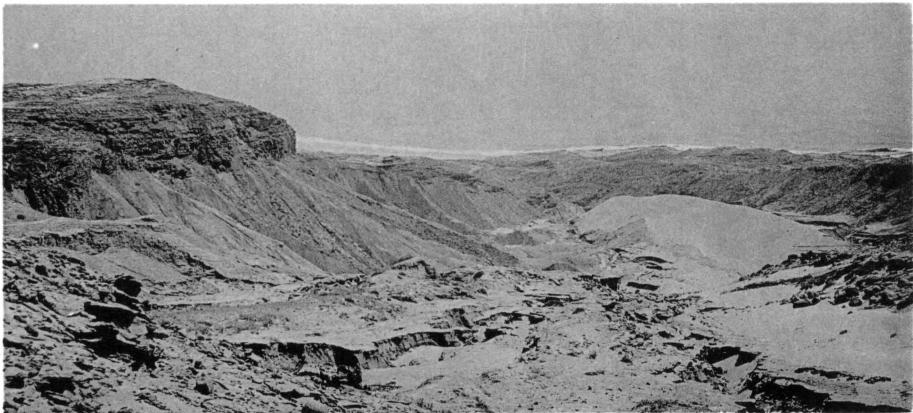


Fig. 52 San Nicolas Island looking southward



Fig. 53 China Point SE end of San Clemente Island



Fig. 54 Pyramid Cove, San Clemente Island



Fig. 55 San Clemente, south side looking NW from China Point



Fig. 56 Santa Catalina Island, SE end

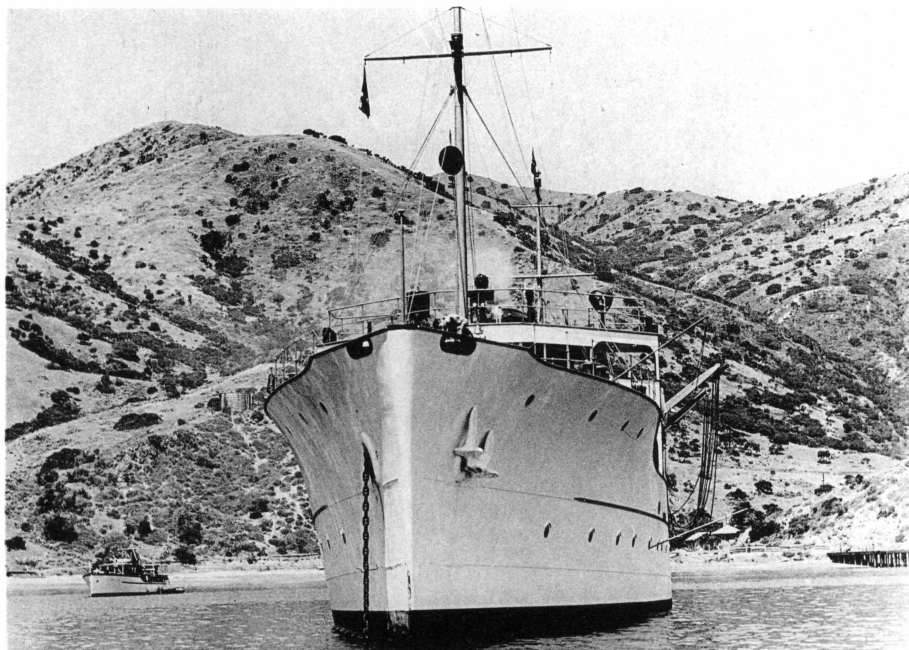


Fig. 57 Santa Catalina Island, *Veleró III* in White Cove



Fig. 58 Point San Vicente light, Palos Verdes hills



Fig. 59 Point Fermin, San Pedro



Fig. 60 Corona del Mar, California, looking southward



Fig. 61 Corona del Mar, California



Fig. 62 Laguna, California, looking northward



Fig. 63 Laguna, California, looking northward



Fig. 64 Guadalupe Island, north end

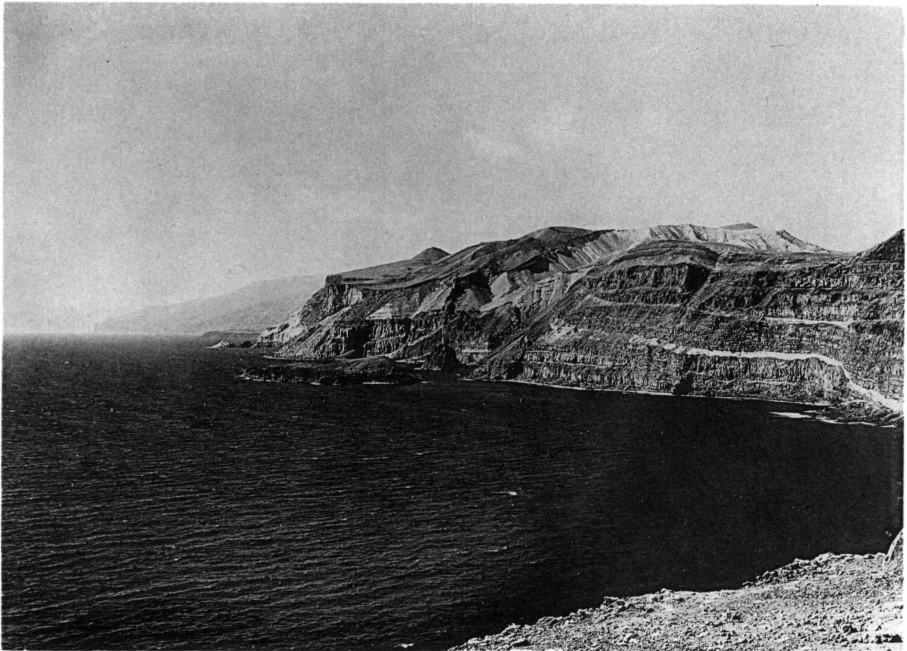


Fig. 65 Guadalupe Island, south end



Fig. 66 Guadalupe Island, Elephant Seal Beach



Fig. 67 East San Benito Island

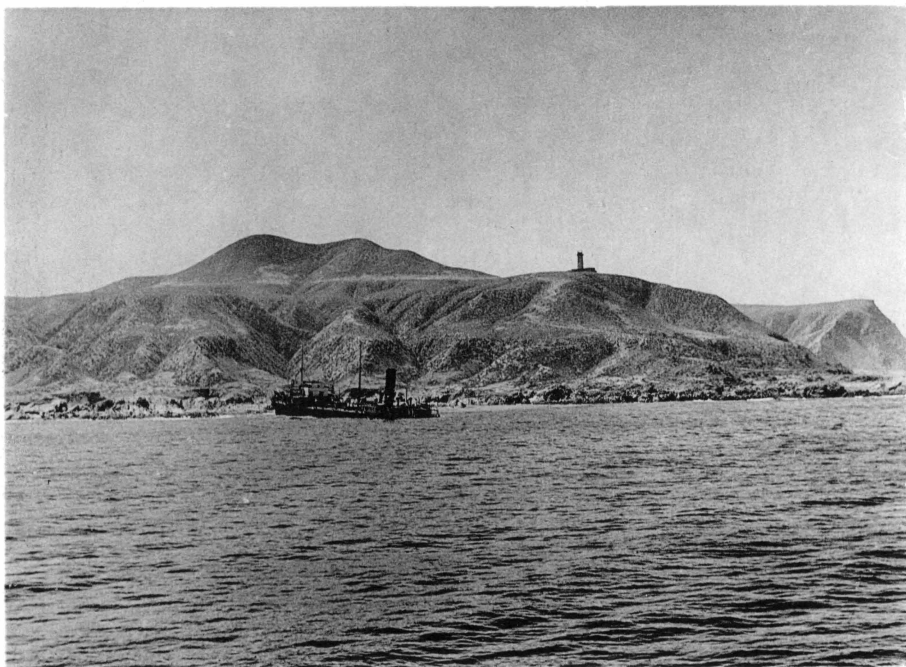


Fig. 68 West San Benito Island



Fig. 69 Village east side of Cedros Island



Fig. 70 Algae, Cedros Island, South Bay



Fig. 71 Cedros Island, South Bay



Fig. 72 Kelp beds, Thurloe Bay, Lower California, Mexico



Fig. 73 Turtle Bay, Lower California, Mexico

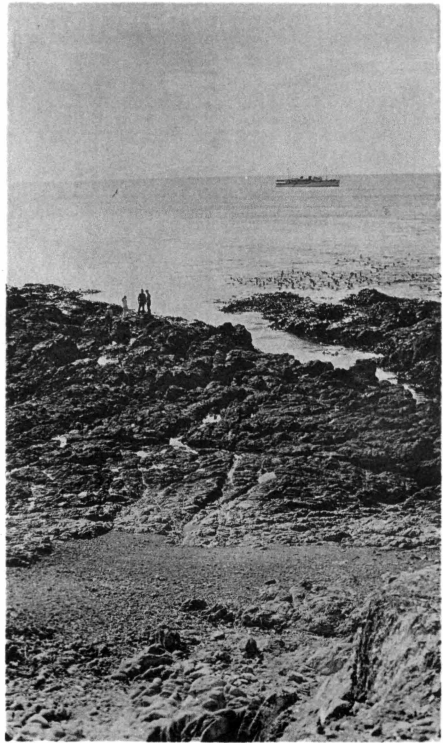


Fig. 74 (right) Asunción Island, Lower California, Mexico

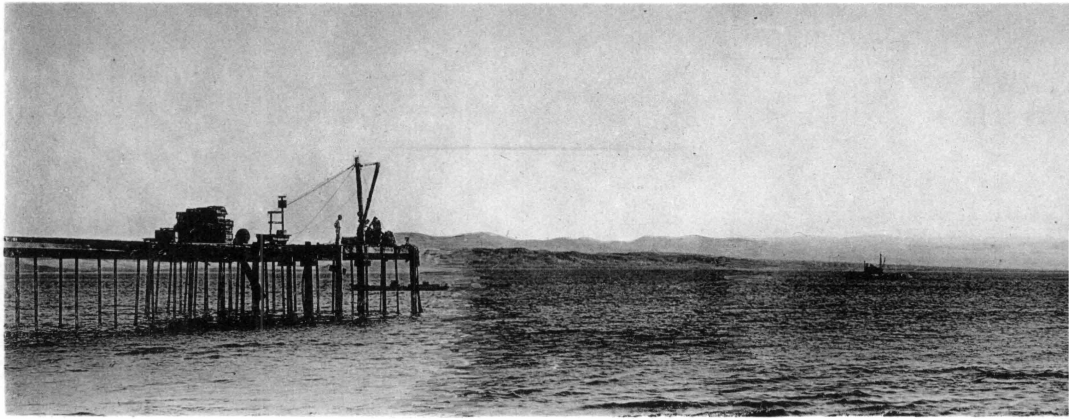


Fig. 75 Panorama of Turtle Bay, Lower California, Mexico

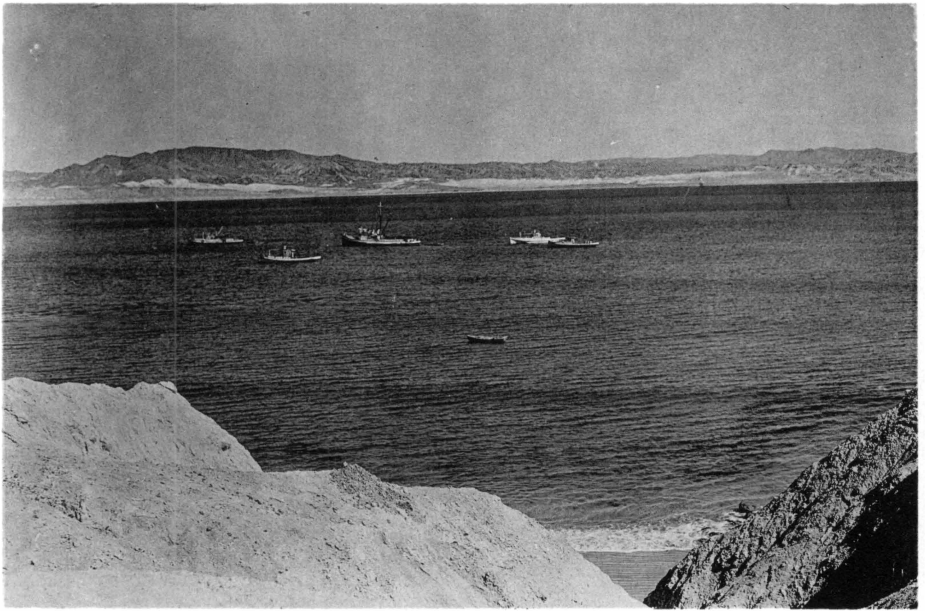


Fig. 76 Turtle Bay, Lower California

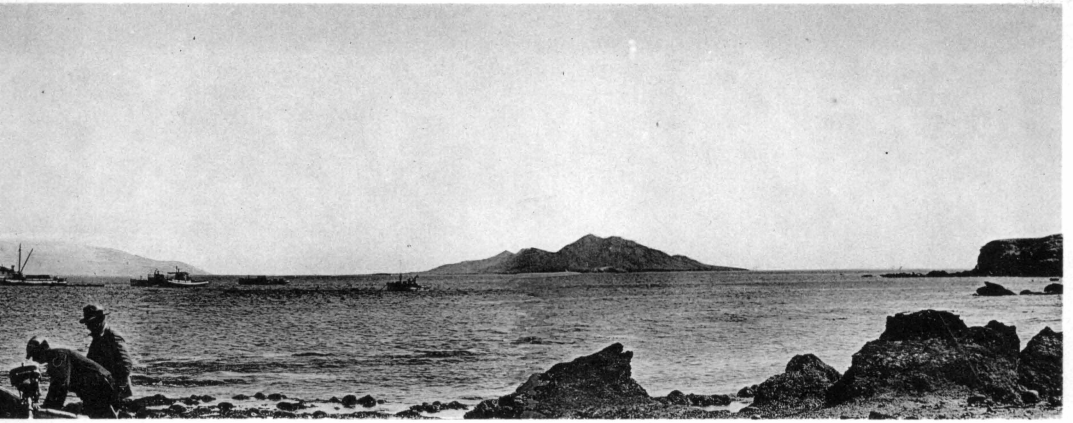


Fig. 77 Turtle Bay, Lower California

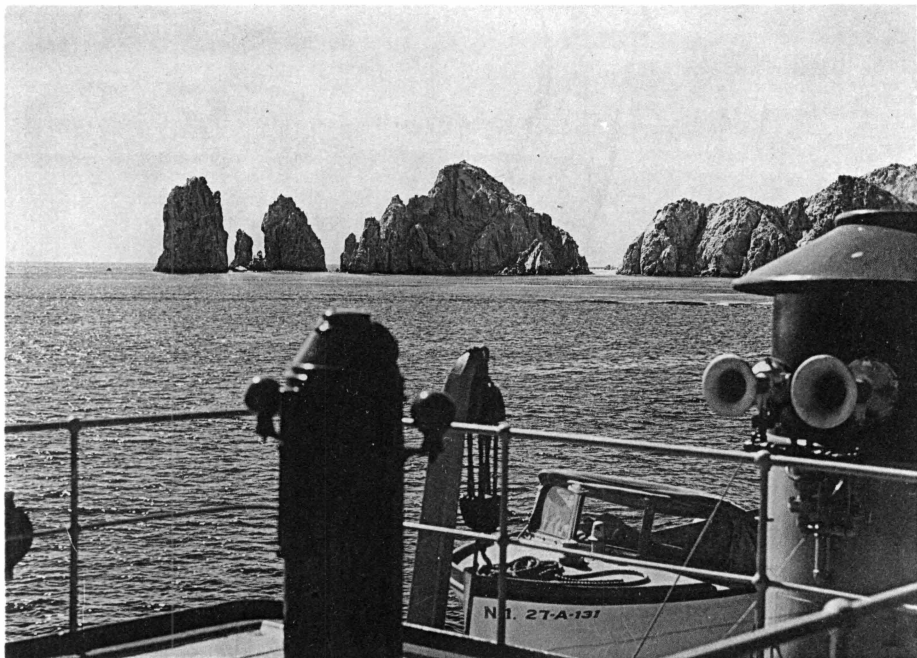


Fig. 78 Cape San Lucas, Lower California, looking west

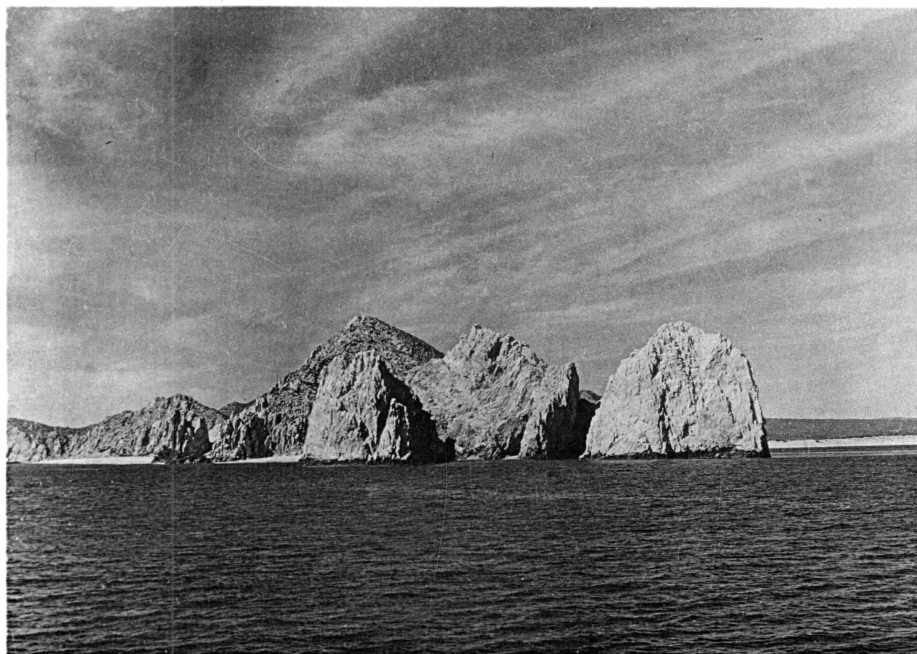


Fig. 79 Cape San Lucas, Lower California, looking north

PLATE 22

- Fig. 47 A view of the northwest side of Santa Barbara Island from a point near the summit. Colonies of California sea lions and an occasional sea elephant inhabit the rocky inlets, while beds of kelp extend for a mile or more off shore. Chart 29, p. 384. (Photographs, figs. 47, 52-55, L. A. Museum—Channel Islands Biol. Survey.)
- Fig. 48 North end of Santa Barbara Island as viewed from the southeast. (Photographs, figs. 48, 50, 51, by Marian B. Hollenbach.)
- Fig. 49 Landing at Santa Barbara Island, California. Stores for a biological survey party of the Los Angeles Museum are being hoisted by means of a temporary scaffolding. Pedestrians take a steep and narrow trail to the summit.

PLATE 23

- Fig. 50 Dutch Harbor, San Nicolas Island, as seen from the east. Chart 30, p. 385.
- Fig. 51 Surf breaking on the mile-long spit at the east end of San Nicolas Island. Here two currents meet, and the spray may be clearly seen for many miles on either side of the island. Chart 30, p. 385.
- Fig. 52 Looking toward the south end of San Nicolas Island from a point near the center of the island. The effects of overgrazing and consequent erosion are clearly seen in the picture.

PLATE 24

- Fig. 53 View of Pyramid Cove, San Clemente Island, showing the surf through which the members of the biological survey party of the Los Angeles Museum were landed from the *Velero III*. Chart 31, p. 385.
- Fig. 54 The south side of San Clemente Island, California, looking northwest from China Point.
- Fig. 55 China Point, the extreme southeast end of San Clemente Island, California, showing the effect of wave action on a level plateau.

PLATE 25

- Fig. 56 The southeast end of Santa Catalina Island, from Pebble Beach to Seal Rocks, has been much blasted to obtain a granitic rock used for building breakwaters. The slope of the island, naturally abrupt at this point, has been greatly steepened by these operations. Evidence that Santa Catalina Island is not rising is found in the absence of elevated beaches and former shore lines. Charts 27, 28, pp. 382, 383.
- Fig. 57 The *Velero III* as she appeared at what was perhaps her most frequented anchorage, at White Cove, south of Long Point, Santa Catalina Island. The wharf, outbuildings, and reservoir were used in connection with the operations of an old mine.

PLATE 26

- Fig. 58 Point San Vicente light as seen from a few hundred yards off shore. The precipitous bluff exposes Tertiary sediments. The Palos Verdes hills represent an uplifted Channel Island, several former shore lines being clearly visible. Chart 25, p. 380.
- Fig. 59 Rocky beach at Point Fermin, California, showing coarse rock shingle and wave-worn sections of uplifted Tertiary deposits. (Photograph by C. McLean Fraser.)

PLATE 27

- Fig. 60 Shore line south of Corona del Mar, California, showing the numerous reefs on which collecting was accomplished, as well as outlying sea stacks and arches. (Photograph by C. McLean Fraser.)
- Fig. 61 Beach south of Corona del Mar, California, a favorite collecting ground for marine zoologists. Chart 26, p. 381. (Photograph by C. McLean Fraser.)

PLATE 28

- Fig. 62 Rocky shore south of Laguna Beach, California, looking north. Chart 26, p. 381. (Photograph by C. McLean Fraser.)
- Fig. 63 Shore line north of Laguna Beach, California, consisting of a number of shallow bays separated by cliffed promontories. (Photograph by C. McLean Fraser.)

PLATE 29

- Fig. 64 Guadalupe Island dwellings constructed of native volcanic rock. The Mexican government maintains a garrison for the protection of the elephant seal herd on the other side of the island. Chart 13, p. 371.
- Fig. 65 The south end of Guadalupe Island affords a glimpse of the effects of volcanism. A cap of lava overlies the stratified deposits of earlier geological periods. It is as if one were viewing the inside of the rim of a crater, the major portion of which had been worn away, allowing access to the crater by the sea.

PLATE 30

- Fig. 66 A portion of a herd of nearly 1,500 of the northern elephant seal, basking on a lava beach at the foot of a talus slope. Behind them the shore of Guadalupe Island rises precipitously to a height of 4,500 feet.
- Fig. 67 The protected west shore of East San Benito Island, breeding ground for thousands of California sea lions. The sandy slopes to the right afford nesting places for western gulls and California brown pelicans. Chart 39, p. 391.

PLATE 31

- Fig. 68 Wreck of a south-bound tanker aground almost at the foot of the lighthouse on West San Benito Island. An ancient shore line is distinguishable at a higher level.
- Fig. 69 The village on the east side of Cedros Island, located on an alluvial fan which represents the third and last of 3 periods of fan formation, the long slope in the distance being the first. (The principal occupation of the inhabitants is the canning of lobster and abalone which abound on near-by rocky shores.)

PLATE 32

- Fig. 70 Algae on shore, South Bay, Cedros Island, Mexico. The conspicuous form with the branching stalk is *Eisenia*. The finer growth in the foreground is eel grass (*Zostera*). (Photograph by Wm. R. Taylor.)
- Fig. 71 The landing at South Bay, Cedros Island, a region of great interest to the geologist, who reports that its formations are precretaceous metamorphics and quaternary volcanics. Chart 40, p. 392.

PLATE 33

- Fig. 72 Beds of *Macrocystis* off shore, Thurloe Bay, Lower California, Mexico. Thurloe Bay marks the southern limit of large kelp beds. The rocks in the foreground represent a series of tilted sediments. (Photograph by Wm. R. Taylor.)
- Fig. 73 Turtle Bay, Lower California, Mexico, showing conglomerate rock in the background and beds of kelp among which collecting was accomplished on an early Hancock Expedition. Chart 42, p. 393.
- Fig. 74 Rocky coast of Asunción Island, Lower California, a favorite breeding ground of the California sea lion. The incessant barking of thousands of these animals made sleep impossible aboard the *Velero III* anchored a mile off shore.

PLATES 34, 35

- Fig. 75 Panorama of Turtle Bay, Lower California, showing Japanese fishing fleet at anchor in the middle distance and Expedition scientists preparing to launch skiff with outboard motor. The harbor entrance is shown at the right.
- Fig. 76 A view looking across the harbor of Turtle Bay, Lower California, from the north shore, showing a portion of the Japanese fishing fleet at anchor in the middle distance.
- Fig. 77 A view of Turtle Bay, Lower California, to the south looking across mud flats toward the beach, which was a favorite collecting ground for edible clams or cockles (*Chione*).

PLATE 36

- Fig. 78 The sea stacks at Cape San Lucas, an important landmark to navigators crossing the Gulf of California. The rocks are seen from the east, or Gulf side, the open Pacific lying beyond them. Chart 45, p. 394.
- Fig. 79 Cape San Lucas as seen from the south appears to be a continuous mass of granite. However, when seen from either west or east, it resolves itself into a number of well-separated stacks and arches allowing passage of the sea between.

Gulf of California—West Coast

Plates 37-60; Charts 48-62

The Gulf of California is an area of major importance in the work of the Allan Hancock Foundation, since it was the main base of operations for three of the winter expeditions, those of 1936, 1937, and 1940. In the attention paid to it, however, it falls relatively short of that paid to the Galapagos Islands, for, although slightly more time has been spent in the Gulf of California, the area included is more than twice as great as that included in the Galapagos area.

The Gulf, separated from the Pacific Ocean by the peninsula of Lower California, is 650 miles long from southeast to northwest and 50 to 120 miles wide. Gales from the northwest in the winter months and from the southeast in the summer months are not infrequent. In several places, especially in the channels between the islands and the mainland, the currents are strong and erratic, and for such an extensive coast line anchorages, safe in all weather, are comparatively few. There are few indications of foul ground such as are commonly present in the open ocean. Nevertheless, in fair weather and under favorable conditions generally, suitable spots for collecting can be found along the shore and on the sea bottom in almost all parts of the Gulf.

The east coast of Lower California, or the west coast of the Gulf, is most commonly high and precipitous, with mountains often rising abruptly close to the shore. There are sandy beaches, but they are seldom of any great length. Depth increases rapidly offshore, but there are numerous islands, often separated from the mainland and from each other by navigable channels. The coast itself, as well as the adjacent islands, has little precipitation; and, while there are some fertile valleys and arroyos, general barrenness is evident.

From the head of the Gulf southward, the east coast is very different from the west coast. Although there are still the high mountains in the background, the immediate foreground is, in the main, low and sandy; and, with the exception of those some distance from shore, most of the islands are in the nature of deltas.

Physical, chemical, and meteorological conditions change materially from the entrance of the Gulf to the head, and with these changes there is, of course, a change in the flora and fauna. The lower portion is tropical, with warm water and corresponding fauna, indicated, for instance, by the presence of coral masses. Toward the head it becomes much colder and less saline, and the tropical species are replaced by those that inhabit

more temperate regions. Such changes are to be expected in such a great extent of coast line, but the changes here are somewhat emphasized by the general configuration.

Following along the west coast of the Gulf from Cabo Falso, or Cape San Lucas, at the entrance, to the mouth of the Colorado River, at the head, consideration is given to the principal collecting locations.

While Cabo Falso is the southern limit of Lower California, it is little farther south than Cape San Lucas, 4 miles to the eastward. The coast between consists of a succession of sandy beaches and forbidding rocky bluffs. A gap in the hills connects one of these beaches, three quarters of a mile westward of Cape San Lucas, with San Lucas Bay, to cut off a high, steep, rocky mass which forms the tip of the Cape. Off this there are a number of outlying rocks, in one of which there is a conspicuous arch through which the sea rushes with great force.

From Cape San Lucas, the coast turns abruptly northward, and then eastward again to form the mile-wide San Lucas Bay, which provides a safe anchorage from northwest winds, but is wholly exposed to the southeast. Several species of commercial fish are plentiful here, and there is a cannery in the village of San Lucas on the shore of the bay. There is one dredging station off the mouth of the bay in 25 fathoms.

Eastward from the sandy beach of San Lucas Bay, a rocky coast extends for 2 miles to Cabeza Ballena, a rocky headland rising almost vertically from the water's edge. From the shore, reeflike, rocky ledges extend seaward, and on these there are some interesting tide pools from which collections have been made. There is one dredging station northeast of the point, close in, and one 3 miles farther to the northeast.

From Cabeza Ballena, the coast continues without any definite irregularity in a northeasterly direction for 10 miles to Palmilla Point. Toward the center of this part there is a low, sandy beach, $2\frac{1}{2}$ miles in length, but the remainder of the shore is rocky.

Palmilla Point, a low, bluff, rocky point, with numerous outlying sunken rocks, is the western limit of San José del Cabo Bay, a shallow bight extending for 9 miles to Gorda Point. The shore is rocky at both ends of the bay, but the remainder, the greater portion, is a sandy beach. The San José valley is one of the most fertile areas in Lower California. The San José River empties into the bay, with San José village situated on its bank, a mile from shore. There is a station on the rocky shore at the west end of the sand beach.

Gorda Point is of the same type as Palmilla Point, with similar outlying rocks. Lying 5 miles southeast of Gorda Point is the Inner Gorda Bank, with a least depth of 17 fathoms, and $2\frac{3}{4}$ miles farther out the Outer Gorda Bank, with a least depth of 34 fathoms. Considerable dredging has been done off Gorda Point and on or near the Inner and Outer banks in sand, rock, and coralline on the banks and in mud off the banks.

From Gorda Point to Los Frailes, 21 miles to the northeast, is a regular coast line trending first to the northeast and then directly to the north, forming a regular convexity, with sandy beaches and rocky patches, backed up by bluffs most of the way. Several arroyos break through the bluff to make connection with the coast. In the southern portion of this area the water deepens very gradually, so that the 100-fathom line may be 7 miles offshore, but the grade is much steeper in the northern part, so much so that this line may be less than a mile from shore. The only collecting done here, except that near Los Frailes, was dipnetting by electric light from the *Velero III* at anchor off Arroyo de San Luis, 10 miles from Gorda Point.

Los Frailes is a prominent, rocky bluff, 410 feet high. Directly to the south of it there is an indentation of the shore to form Los Frailes Bay. The depth of the water offshore increases rapidly. Shore seining in the bay, dredging in shallow water in the bay and off the point, dredging off the bay in 80 fathoms, and the collecting of land plants indicate the activities in this location.

From Los Frailes to Cape Pulmo, 4 miles, where there is a rocky bluff, and on to Arena Point, 7 miles, there is a sandy beach the most of the way with some rock patches ashore and offshore, and several shoals offshore.

From Arena Point the coast turns to the northwest and then to the north again to Pescadero Point, 21 miles along the shore, and 19 miles in a straight line from point to point, to form Palmas Bay, largely a stretch of sandy beach interrupted occasionally by rocky patches or bluffs, with deep water quite close to shore.

The only collecting along this coast from near Los Frailes to Pescadero Point was some dredging in 50-150 fathoms off Boca de la Trinidad, 5 miles north of Arena Point.

From Pescadero Point to Perico Point, 15 miles, there is another somewhat similar indentation, Muertos Bay. The southern portion of the shore is sandy, but the northern portion is more rocky. Not far south of

Perico Point is a secondary indentation to form Ensenada de Los Muertos, in which there is an anchorage, safer than most of those along this part of the coast. This Ensenada has afforded some shore collecting and some dredging in 5-40 fathoms, in sand, broken shell, and coralline.

Perico Point is a high, rocky bluff; and here the coast turns slightly west of north, 2 miles, to the low, sandy Point Arena de la Ventana, north of which is a deeper bight to form Ventana Bay. Point Gorda, 12 miles from Point de la Ventana, is the northwestern limit of the bay.

The repeated use of certain names along the whole Pacific coast of America, south of San Diego, is quite confusing at times. This Point Gorda is not more than 70 or 75 miles in a direct line from a Point Gorda recently mentioned.

Lying off Ventana Bay is the high, rocky, barren island, Ceralbo Island, 16 miles long, $4\frac{1}{2}$ miles wide, with Ceralbo Channel, 4 to 6 miles wide, separating it from the mainland.

From Point Gorda to Coyote Point, 16 miles, the bold, rocky coast extends northwesterly. The bays and the points between them in this distance are not significant.

No collecting has been done around Ceralbo Island or at any place between Perico Point and Coyote Point.

Coyote Point is the northeast point of a rectangular peninsula separating La Paz Bay from the open Gulf. The northwest point is San Lorenzo Point. The coast between, 5 miles, is mostly rocky, although there is a sand beach near the San Lorenzo end. This peninsula is separated from Espiritu Santo Island by San Lorenzo Channel, with a least width of $3\frac{1}{2}$ miles. The channel is foul with rocks and reefs, and the currents are strong and variable. Probably because of this condition the fauna is rich, and hence the extensive dredging here was very profitable.

Espiritu Santo Island, 8 miles long, 6 miles wide, has a coast line of bluffs and sandy beaches. It is separated from Isla Partida to the north of it by a narrow, shallow passage. On the west coast of the island are two indentations, neither very extensive—Port Ballena and San Gabriel Bay—the latter being much the larger. San Gabriel Bay has been a fertile collecting ground for all methods of collecting that have been used anywhere. Port Ballena has received some attention as well.

La Paz Bay is the largest bay on the east coast of Lower California. It is 43 miles long, north and south, with a greatest breadth of 18 miles. The main coast line is shaped like the letter "J" reversed, with the peninsula extending to San Lorenzo Channel supporting the short arm.

Espiritu Santo Island and Isla Partida shut off most of the remainder from the open Gulf. There is little sandy beach, the rocky shore forming high bluffs and projecting points in many places.

San Juan Nepomezeino Island, off the west side of the peninsula, 4 miles from San Lorenzo Point, serves to protect Pichilique Harbor to the south of it and helps to make this harbor one of the best on the coast. It is well that this is so, for the southern portion of La Paz Bay, affording approach to the city of La Paz, is all quite shallow. The southern extremity of the bay forms La Paz Harbor, on which the city of La Paz, the largest city in Lower California, is situated. A large lagoon, *Ensenada de Anpe*, extends southwestward from the harbor.

There are shore, electric light, and dredging stations at the entrance to Pichilique Harbor and off Prieta Point, a short distance south.

The only conspicuous point on the west shore of La Paz Bay is Coyote Point. The northern terminus is Mechudo Head, a bold, perpendicular, stratified cliff 300 feet high. There is one dredging station off this head in 43-44 fathoms, but none in the main portion of La Paz Bay.

From Mechudo Head the coast extends regularly to the northwest, 16 miles, to Nopolo Point. Off this portion of the coast and separated from it by San José Channel lies San José Island, 16½ miles long, 2 to 6 miles wide, with more vegetation than some of the other gulf islands. South of this island, 1½ miles, is San Francisco Island, 4½ miles off Mechudo Head. The channel between is shallow and is blocked to some extent by Coyote Rocks and others of smaller size. The area of the island is 1½ square miles. The coast consists mainly of rocky bluffs, but there is a low, sandy neck connecting the southern tip with the rest of the island. All around the island the water is comparatively shallow, but deepens rapidly to the eastward. This has been a favorite collecting area. Much dredging, shore collecting on the rocks and on shingle, and for coral masses, and dipping with electric light have all brought good results.

North of San José Island are the rocky islands or islets, San Diego and Santa Cruz.

From Nopolo Point to San Marcial Point, 32 miles, the coast continues regularly somewhat west of north, with but one conspicuous point between, Point Telmo. The coast is a succession of rocky bluffs and small sand beaches. There are a number of small islands and rocky islets a short distance offshore.

San Marcial Point is a rocky cliff with a long reef of rocks extending out from it, and $1\frac{1}{4}$ miles north-northeastward is San Marcial Rock. Just north of San Marcial Point, the coast turns abruptly westward, 2 miles, to Agua Verde Bay, where there is a fair anchorage. The bay is surrounded by rocky bluffs, but there are two small sandy beaches.

The San Marcial Point and Agua Verde Bay area has been a favorite collecting location; 26 stations are located here, with all types of equipment used. The work here consisted of shore collecting in the sand and on the rocks at low tide and with the use of a skiff, collecting on San Marcial Reef, seining, dipping and diving, dredging in the shallow water in sand, and in deeper water to 127 fathoms, mostly in mud.

West of Point San Pasquel, the western extremity of Agua Verde Bay, is a small bight, 5 miles across to San Cosme Point, and then another, larger bight to Candelero Point, 11 miles across, with a succession of rocky bluffs and sandy beaches. Off Candelero Point lie three pinnacle rocks, Los Candeleros.

Another bight extends from Candelero Point to Punta Coyote, 7 miles. There are some sandy beaches and outlying rocks. Punta Coyote is a steep, bluff headland, forming the eastern limit of a pear-shaped peninsula, joined by a narrow neck to the mainland, which forms a well-protected and almost landlocked harbor, Puerto Escondido. Here there is some shingle beach, rather a rarity in the Gulf. The bight is pretty well shut off from the open Gulf by Danzante Island, $3\frac{1}{2}$ miles long. Off Punta Coyote and in and off Puerto Escondido and in the channel between these and Danzante Island, there are 19 stations, at which practically all types of collecting were used. The bottom here is mostly sand.

From Punta Coyote the coast takes a regular sweep almost directly northward to Tierra Firme Point, 15 miles, with but one noticeable point between, Nopolo Point. Much of the coast here is low and sandy.

Opposite this part of the coast lies the large Carmen Island, $17\frac{1}{2}$ miles long and 6 miles in greatest width, with its southern point, Punta Baja, $3\frac{1}{2}$ miles from Punta Coyote. The general appearance of the island and of its coast does not differ materially from that of the near-by mainland. The northern portion of the island forms a rough square, and the remainder extends as a peninsula from 2 to 3 miles wide to Punta Baja. Between the base of the peninsula and Perico Point, the southeastern point of the main part of the island, is the well-protected Salinas Bay. There are one dredging station in Salinas Bay in sand bottom and two in mud bottom in the channel between the southern peninsula and the mainland.

A low, sandy bluff extends northward 2 miles from Point Tierra Firma, and lying off this bluff $1\frac{1}{2}$ miles is an irregular island, Coronados Island, $1\frac{3}{4}$ miles by $1\frac{1}{2}$ miles. Nearly all the coast of this island is steep and rocky, but a low, sandy, and stony spit extends to the southwestward. South of Coronados Island, there are dredging stations in coralline, sand, and broken shell.

From the north end of the Tierra Firma Point, the coast, mostly bold and rocky, extends slightly west of northward for 11 miles and then turns abruptly eastward to form Mangles Point, thus forming a shallow anchorage, Mangles Anchorage, where shore collecting and dredging in rather shallow water have been done.

From Mangles Point to Pulpito Point, 15 miles, there is a similar trend in the coast line except that the northern half of it recedes somewhat to form San Basilio Bay. Pulpito Point is conspicuous because of the fact that, although the headland is 500 feet high, the connection with the mainland is very much lower, so that at a distance it appears to be an island. The point protects an anchorage in much the same way as Mangles Point does. There are 2 dredging stations off the Point, one in 14 fathoms and the other in 55 fathoms.

North of Pulpito Point, $1\frac{1}{4}$ miles, is Santa Antonita Point, after which the coast recedes to the westward and then turns northward again to form San Nicolas Bay, terminating to the northward in Santa Teresa Point. The bay is 11 miles across the entrance. Opposite the center of the bay, 5 miles offshore, is Ildefonso Island, a barren rock, $1\frac{1}{4}$ by $\frac{1}{2}$ mile in extent. Collecting has been done on the rocky shore of the island, and dredging in 50 and in 190 fathoms between the island and the mainland.

From Santa Teresa Point, the coast extends northwesterly to Point Concepción, 20 miles, with only one sizable point between, Colorado Point, $4\frac{1}{2}$ miles from Santa Teresa Point.

Point Concepción is an ill-defined point at the extremity of a peninsula that lies between Concepción Bay and the open Gulf. Considerable dredging has been done off the end of the peninsula in bottom in which both live and dead shells (*Strombus*) were conspicuous.

Concepción Bay extends southward for 22 miles with an entrance channel 2 miles wide, but widening farther in to as much as 5 miles. The eastern shore and the head of the bay are regular in outline and consist mainly of sand and pebble beaches. The western shore is much more irregular, with one conspicuous indentation, Coyote Bay, and with many islands, islets, and shoals. There are numerous bluff points with sand

beaches between, but most of the coast near the entrance is bold and rocky. San Pedro Point, which forms the northern limit of Coyote Bay, is bold and rocky, but its connection with the mainland is low and sandy.

Collecting in Concepción Bay has been restricted to the Coyote Bay area, where shore collecting, dipping by electric light, and dredging received some attention.

From Galleto Point, the northwest extremity of Concepción Bay, it is 4 miles to Colorado Point, where the coast line makes a long sweep to form Santa Inez Bay, $8\frac{3}{4}$ miles across to Santa Inez Point, off which are the three Santa Inez Islands. The coast here is lower, and the headland bluffs are not so high. Most of the shore in Santa Inez Bay is sandy beach.

From Chivato Point, $1\frac{3}{4}$ miles from Santa Inez Point, to Santa Teresa Point, over 100 miles away, there are few distinctive geographic features. The coast, in general, is low and sandy, and even the points may be low, although some of them may be rocky. The depth of the water, as elsewhere, increases rapidly offshore. The only harbor of importance is at Santa Rosalia, 23 miles from Chivato Point, where two breakwaters serve as a protection. Santa Rosalia is an important mining town, with smelters.

Lying off the southern part of this coast, $2\frac{1}{2}$ miles from shore, is San Marcos Island, $5\frac{1}{2}$ miles long and $1\frac{1}{4}$ to $2\frac{1}{2}$ miles wide. The eastern and northeastern shores are bold and rocky, but the others are low, generally made up of sand beaches. A sandy shoal extends for some distance south from the south end of the island. There are dredging stations to the east, southeast, and south of the island.

Tortuga Island, 2 miles by 1 mile, lies 15 miles northeast of the northern end of San Marcos. It is rugged and barren, but some land plants were collected from it. A series of dredging stations extend southward from the southern shore, into 83 fathoms.

Santa Teresa Point is a rocky bluff with a high hill back of it, the whole forming a headland connected with the mainland by a low neck of land, with sand beaches on each side. This headland forms part of the boundary of two bays, Santa Teresa Bay to the south and San Francisquito Bay to the north. The northwest point of the headland is San Gabriel Point, forming the eastern point of San Francisquito Bay.

There are several dredging stations in and off San Francisquito Bay and off San Gabriel Point, in depths to 165 fathoms, and in a great variety of bottom.

There are 2 miles of steep, rocky bluffs from the western entrance of San Francisquito Bay to San Francisquito Point, where San Rafael Bay, a large open bay, opens up. Its shores are mostly low and sandy, but there are some rocky bluffs. It is 25 miles across the entrance. Three miles farther on is Las Animas Point at the entrance to Las Animas Bay, an indentation deeper than wide, $6\frac{1}{2}$ miles across. Opposite San Rafael Bay are the San Lorenzo Islands, three of them in a series from southeast to northwest, the southernmost one, the largest, nearly 10 miles long. Almost in line with these, but a little to the eastward, are Isla Raza, quite small, Isla Partida, somewhat larger, and, finally, the large island, Angel de la Guardia.

Isla Raza, 11 miles off the mainland, $\frac{3}{4}$ mile by $\frac{1}{2}$ mile, is whitened with guano. Around it and also around Isla Partida are several outlying rocks, some of them of considerable size. Isla Partida, $1\frac{1}{4}$ miles by $\frac{1}{2}$ mile, is $4\frac{1}{2}$ miles from Isla Raza, and 6 miles from the southern tip of Angel de la Guardia Island. Both islands are rocky and barren. Between them and around them there are, at times, strong currents and tide rips.

Angel de la Guardia is a high, rocky, barren island, 42 miles long, with a greatest width of 10 miles, separated from the mainland by Bal-lenas Channel, with minimum width of 8 miles. The east side is deeply indented, but the west side is more regular, bold, and rocky, with no suitable anchorages. Four miles from the tip on the east side, the coast extends outward to form a point that is connected by a reef, covered in part, at high water, with Pond Island, 1 mile by $\frac{1}{4}$ mile. Between Pond Island and Rock Point, 13 miles to the northwestward, is an open bay, and there is another between Rock Point and Bluff Point, $14\frac{1}{4}$ miles farther on. Bluff Point is the tip of a bold, rocky headland, the north-eastern extremity of the island.

Nearly all the north end of the island is taken up with Puerto Refugio, which consists of two well-separated harbors. The eastern harbor is shut off to the northward, to some extent, by Granite Island, and the western harbor entirely so by the larger island, Mejia; an island over half a mile long, unnamed on the charts, separates the two harbors. The port and its shores provide a great variety of conditions—sandy beaches, rocky points, reefs, shoals, and deep water—and many picturesque views to attract the photographer.

The locations explored through collecting have been (1) the southern area on the east side of Angel de la Guardia Island, from Pond Island to the southern tip, and on to include the areas around Isla Partida and

Isla Raza (here there are 15 stations); and (2) the Puerto Refugio region, where there are over 30 stations. In both areas the fauna is rich, and much good material has been obtained by all methods of collecting.

Returning to the mainland, Las Animas Bay is separated from Angeles Bay, the next to the northwest, by a peninsula 5 miles across that terminates in a series of rocky bluffs and sharp, rocky points. Angeles Bay, 4 miles across, is well landlocked, as an extensive series of small islands, the largest of which is South Island, shuts it off from Balenas Channel. There are safe passages between the islands, however, and Angeles Bay provides a really safe harbor, although the water is not deep. Most of the shore consists of sandy beaches, but there are some rock and shingle. A long sandspit extends southwestward from the northern limit of the bay. Some shore collecting has been done here, but much more has been done by dredging, mostly in sand, in and off the bay.

From the northern extremity of Angeles Bay to Point Final, at the entrance of Gonzaga Bay, 46 miles, there is little variety in the coast line. It consists of regular, high, rocky bluffs, with the exception of the low, sandy portion at Remedios Bay and Remedios Point, 12 miles from Angeles Bay.

Bluff Point is opposite the north end of Angel de la Guardia Island. Gonzaga (San Luis Gonzales) Bay is a semicircular bay, with low, sandy, or gravelly shore, between Point Final and Willard Point, 8 miles. Just south of Willard Point there is a secondary indentation, Willard Bay. Separated from the head of the bay by a narrow strip of sand is a shallow lagoon. Shore collecting in sand, shingle, and rock and dredging in sand and mud have provided several stations in and near Willard Bay and Gonzaga Bay.

Along the coast from Willard Point to Point San Felipe, 78 miles, there are no special features. The coast is low and sandy, and even the two most important points, Fermin and Diggs, are not discernible at any great distance. Off the southern portion there are some small islands, the largest of which is San Luis Island, 13 miles from Point Final. It is volcanic, but a low sandspit extends for some distance from the southwestern end of the island. There is one station near this sandspit, where pectens were found in abundance in 10 fathoms, sand. Point San Felipe gives some protection to the shallow San Felipe Bay to the south of it. The shore is low and sandy, but there are some rocky bluffs. There are two dredging stations in the bay, one in sand and the other in mud.

The conspicuous Consag Rock (Ship Rock), whitened with guano, lies $18\frac{1}{2}$ miles east-northeastward of Point San Felipe. Around it are several outlying rocks. Near by the water is shallow everywhere, and is very muddy. Strong currents and tide rips are noticeable. Some shore collecting has been done here, and there are several dredging stations in the vicinity. In two of the hauls basketstars were abundant.

The *Velero III* has not gone farther toward the head of the Gulf than Consag Rock, but, according to the *Coast Pilot*,

The coast from Point San Felipe to Sargent Point, at the mouth of the Colorado River, about 38 miles to the northward, is low and backed by plains that rise gradually towards the mountains in the interior. Mud flats and shoals that dry at low water extend offshore $1\frac{1}{2}$ to 6 miles. Parts of this coast are subject to overflow at times during heavy freshets and at highest spring tides.

PLATE 37

- Fig. 80 The landing place at Los Frailes is a sandy beach behind the granite promontory which marks the northern limit of the bay. The ranch house is located a few hundred yards to the interior, and some of the higher mountains of the cape region are shown in the left background.
- Fig. 81 Promontory of massive granite which marks the anchorage at Los Frailes. Granitic rocks were encountered at the tip of the Lower California peninsula and again at Granite Island, off the north end of Angel de la Guardia Island, near the head of the Gulf.

PLATES 38, 39

- Fig. 82 A panorama showing the complete west side of Espiritu Santo Island, Gulf of California, and including within its scope Ballenas and San Gabriel bays. The picture was taken from a small, nameless island in La Paz Bay. Chart 52, p. 397.
- Fig. 83 Spectacular headland located on the west side of Espiritu Santo Island, Gulf of California, showing clearly the result of bedding.
- Fig. 84 The Isthmus of Espiritu Santo Island, Gulf of California, showing the bay at low tide and giant cacti in the foreground.
- Fig. 85 At extreme low tide heads of coral and encrustations of worm tubes are bared in the shallow bays along the east coast of Espiritu Santo Island, facing the larger La Paz Bay, Gulf of California. An Expedition member is here shown digging the hatchet clam or *Pinna*. Chart 51, p. 397.
- Fig. 86 Sandstone headland on the west side of Espiritu Santo Island, south of San Gabriel Bay, Gulf of California. The bluff shows stratification and brilliant coloration. Its flat top is suggestive of volcanic capping.

PLATE 40

- Fig. 87 San Gabriel Bay, Espiritu Santo Island, a shallow inlet of La Paz Bay backed by a mangrove-encircled lagoon, the outlet of which is shown at the right of the picture. A narrow arch of beach separates the lagoon from the bay.
- Fig. 88 San Gabriel Bay, Espiritu Santo Island, Gulf of California. The white sand is backed by mangrove trees behind which rise mountains of sedimentary origin capped by harder volcanic material which has retarded their disintegration.

PLATE 41

- Fig. 89 Lighthouse at Prieta Point, Lower California, marking the entrance to the harbor at La Paz. The mountains in the background were once continuous with those of Espiritu Santo Island to the north. Chart 51, p. 397.
- Fig. 90 Beach at La Paz, Lower California. The city itself is situated on a shallow lagoon shown at the right. Vessels of large draught must anchor outside, off Pichilique Harbor. Chart 51, p. 397.

PLATE 42

- Fig. 91 View of Agua Verde Bay, Lower California, from the north shore. One of the secluded bays in which collecting was done may be seen in the background, another in the background to the left of the *Velero III*.
- Fig. 92 View of Agua Verde Bay from the north shore showing village site along the margins of the wash in the right background. The slope in the foreground adequately represents the chief types of vegetation on the dry hillsides in the vicinity. Chart 54, p. 398.

PLATE 43

- Fig. 93 Sea stack which stands in the south cove at Agua Verde Bay, Gulf of California. An osprey's nest was built upon its topmost pinnacle.
- Fig. 94 The dock at Salinas Bay, Carmen Island, Gulf of California. An extensive salt works is served by a short railway upon which the sacked salt is transported to lighters which transfer it to cargo vessels. *Velero III* may be seen in the distance. Charts 54, 55, p. 398.

PLATE 44

- Fig. 95 A bold headland of metamorphic rock marks the entrance to Concepción Bay, Gulf of California, an indentation of the peninsula nearly twenty miles long and from one to several miles wide, with anchorage depths to seventeen fathoms. Chart 56, p. 399.
- Fig. 96 The Sierra de la Giganta rises almost vertically from the shores of Escondido Bay. The mile-high mountains consist of bedded sediments, the erosion being similar to that of the Grand Canyon.

PLATE 45

- Fig. 97 Canyon in the Sierra de la Giganta, Escondido Bay, Lower California, showing *Washingtonia* palms (*Washingtonia filifera*) and other characteristic vegetation of the region.
- Fig. 98 Escondido Bay, Gulf of California, seen from a mile or more inland. The island of Danzante is seen in the right background, Carmen Island in the left background. The estuary between the landlocked body of water at the left and the open bay to the right passes behind the hill in the middle distance.

PLATES 46, 47

- Fig. 99 (A panorama.) Escondido Bay, Lower California, showing Puerto Escondido in the extreme left, the islands of Carmen and Danzante in the middle distance and the Sierra de la Giganta to the right. The *Velero III* may be seen at anchor below the north end of Danzante Island.
- Fig. 100 The road from Mulege to La Paz follows the western shore of Concepción Bay and in places has been cut out of the rock. The formation shown is a breccia probably representing an ancient alluvial fan.
- Fig. 101 The region north of Puerto Escondido shows clearly the effects of submergence. The hills to the right are slowly being "drowned," their valleys becoming shallow bays. A typical hacienda is shown at the clearing at the left.

PLATE 48

- Fig. 102 San Marcos Island, Gulf of California, seen from the deck of *Velero III* during dredging operations. Chart 57, p. 399.
- Fig. 103 Tortuga Island, Gulf of California, viewed from the south side. The rim of the crater is of lava, the lighter-colored material ash. No recent volcanic activity has been observed. Chart 57, p. 399.
- Fig. 104 Interior of the crater at Tortuga Island, Gulf of California, showing alternate beds of lava and volcanic ash. The crater rim is unbroken and is half to three quarters of a mile in diameter.



Fig. 80 Los Frailes, Mexico, landing place



Fig. 81 Los Frailes, Mexico

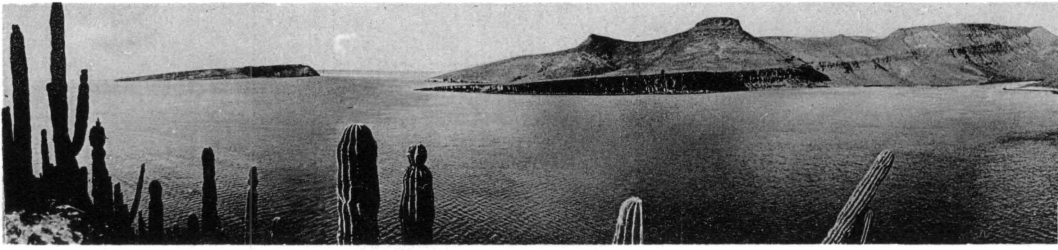


Fig. 82 Panorama, Espiritu Santo Island from the west

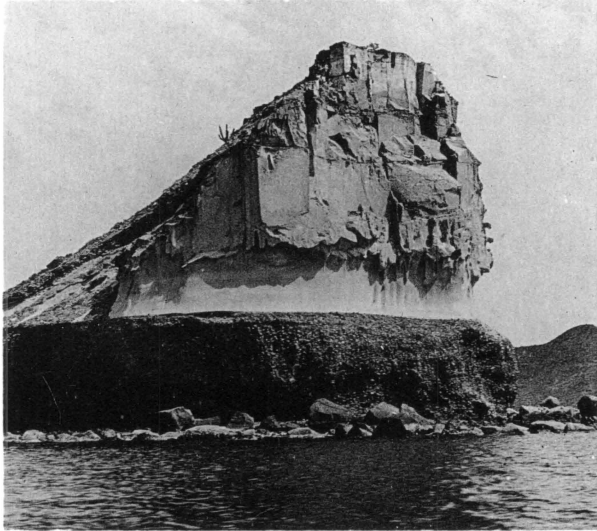


Fig. 83 Espiritu Santo Island, headland south of San Gabriel Bay



Fig. 84 Espiritu Santo Island looking toward La Paz Bay

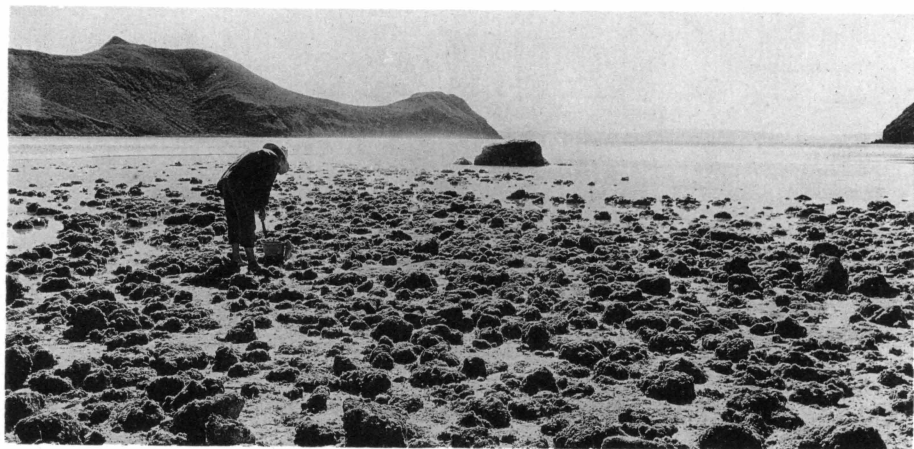
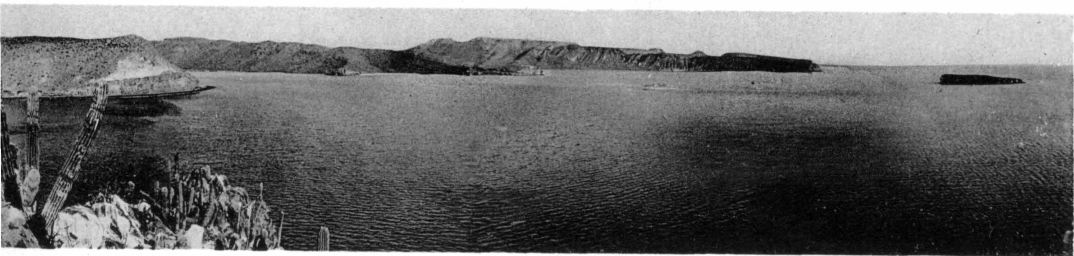
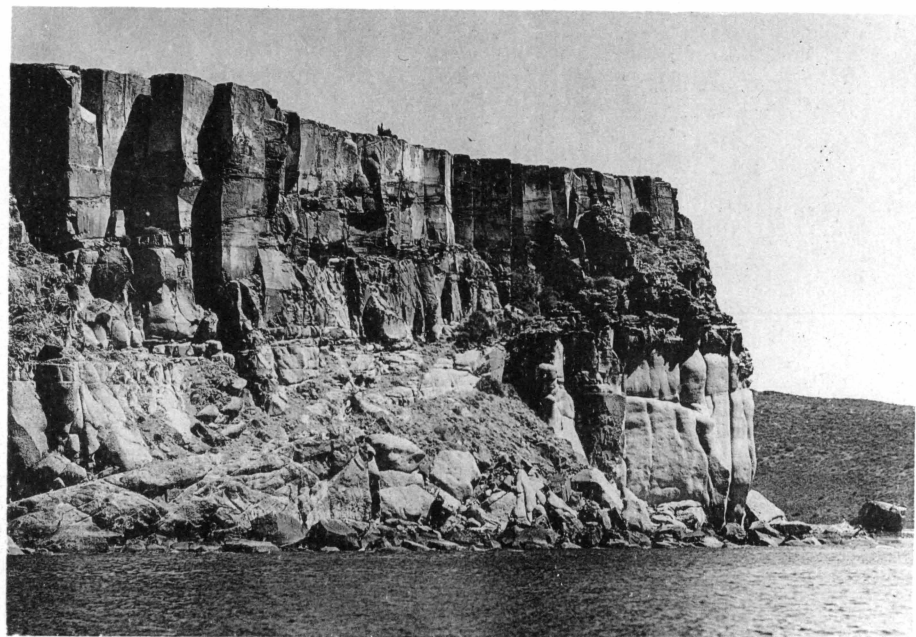


Fig. 85 (*above*) Espiritu Santo Island, coral heads, low tide
Fig. 86 Espiritu Santo Island, headland, San Gabriel Bay



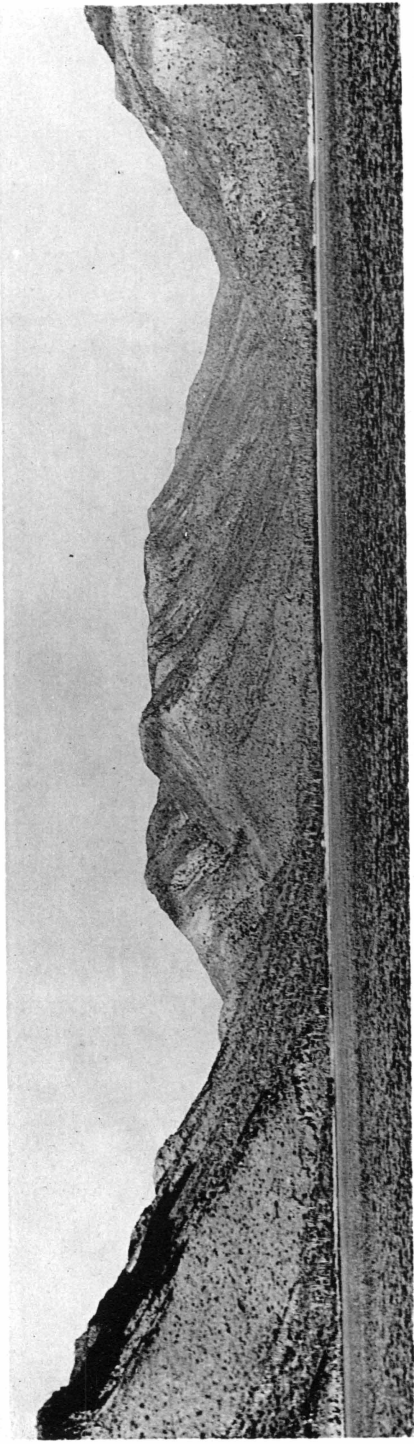
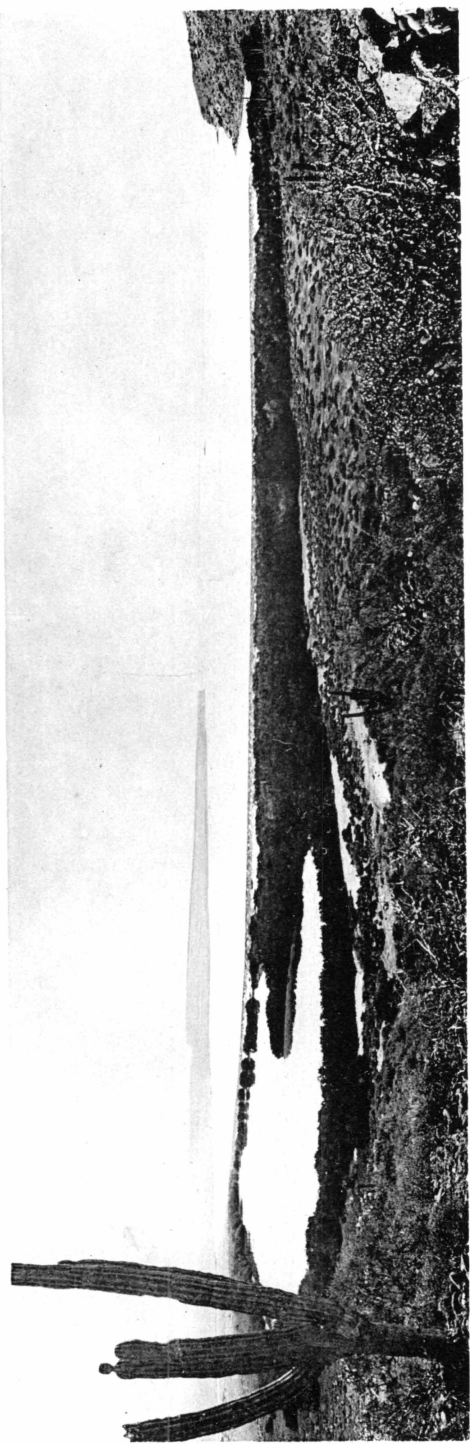


Fig. 87 (*above*) Espiritu Santo Island, panorama of San Gabriel Bay
Fig. 88 San Gabriel Bay, Espiritu Santo Island

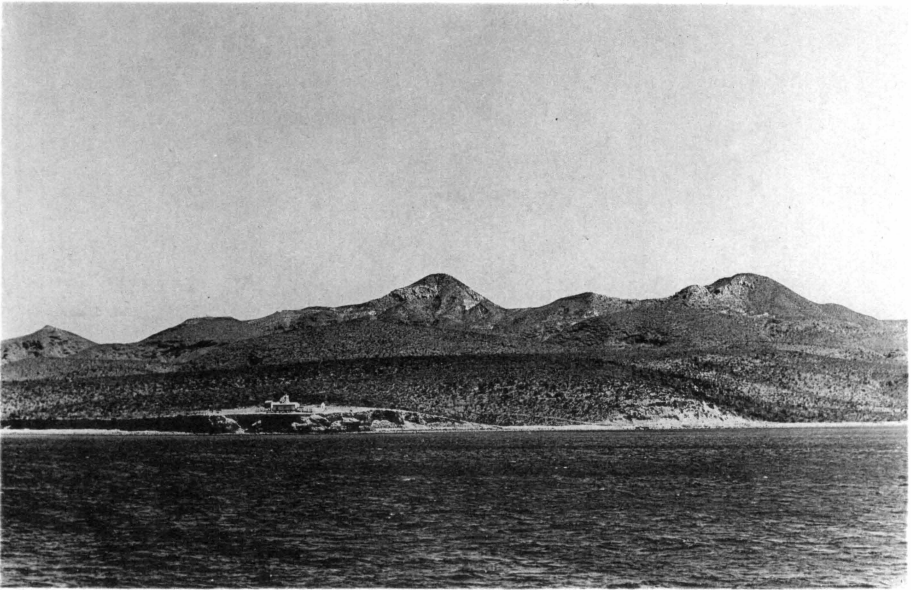


Fig. 89 Prieta Point, Lower California, Mexico

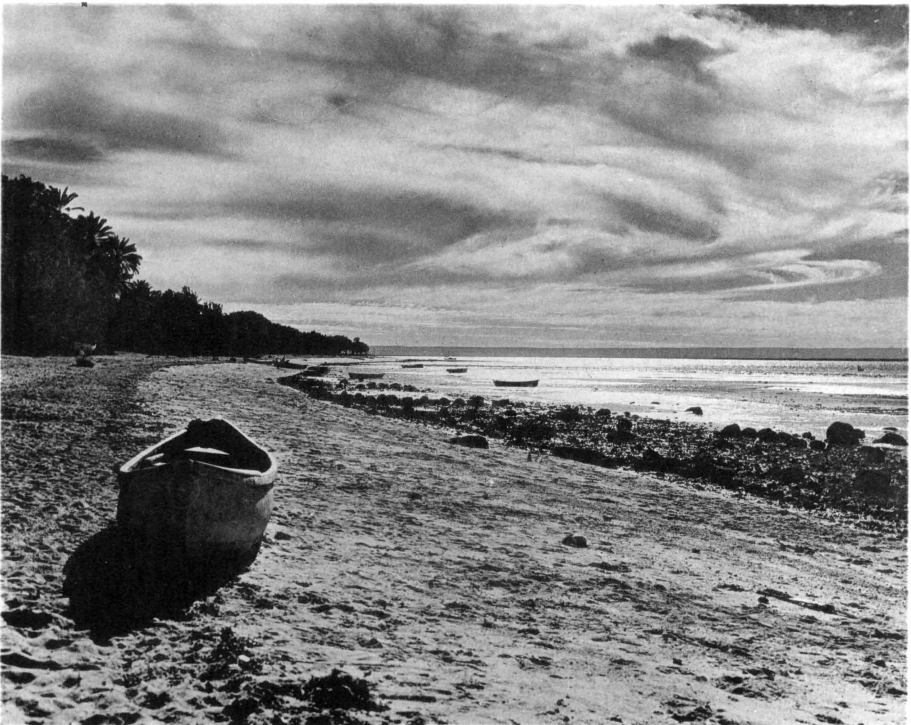


Fig. 90 La Paz, Lower California, Mexico



Fig. 91 Agua Verde Bay, north shore, Gulf of California



Fig. 92 Agua Verde Bay, north shore, Gulf of California

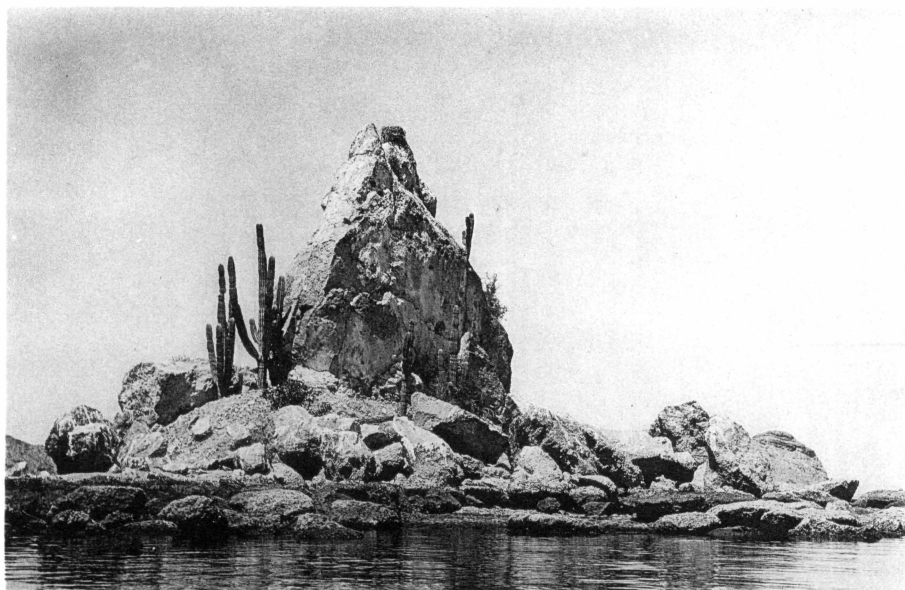


Fig. 93 Sea stack, Agua Verde Bay, Gulf of California



Fig. 94 Carmen Island, Salinas Bay, Gulf of California

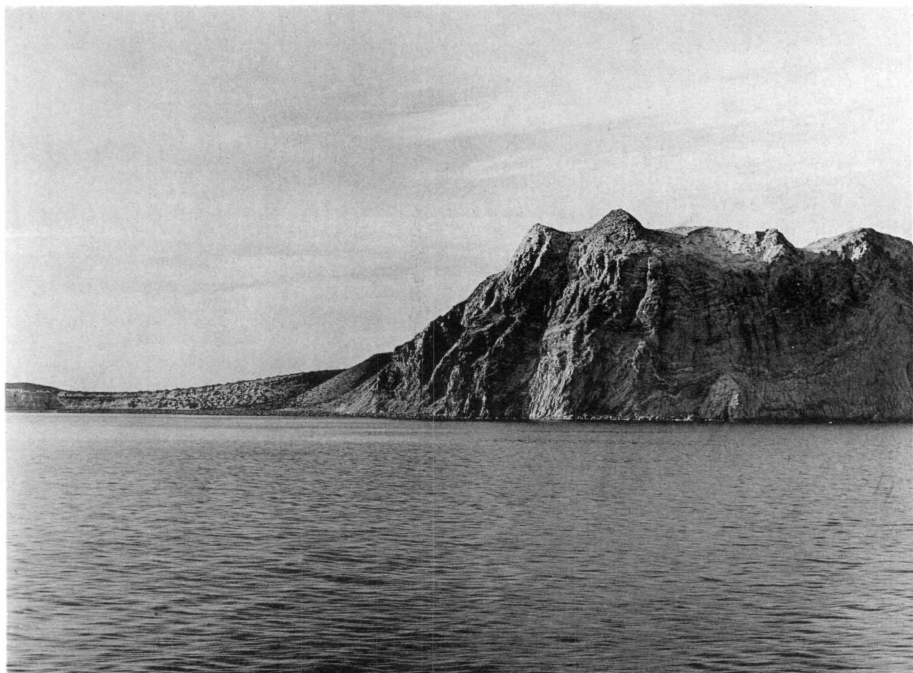


Fig. 95 Entrance to Concepción Bay, Gulf of California



Fig. 96 Sierra de la Giganta, Escondido Bay, Gulf of California



Fig. 97 Looking toward Sierra de la Giganta, Escondido Bay, Gulf of California



Fig. 98 Escondido Bay, Gulf of California

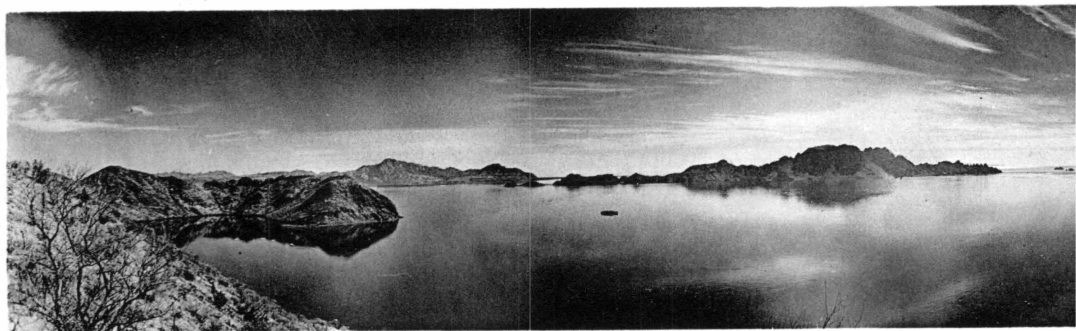


Fig. 99 Panorama, Escondido Bay, Gulf of California

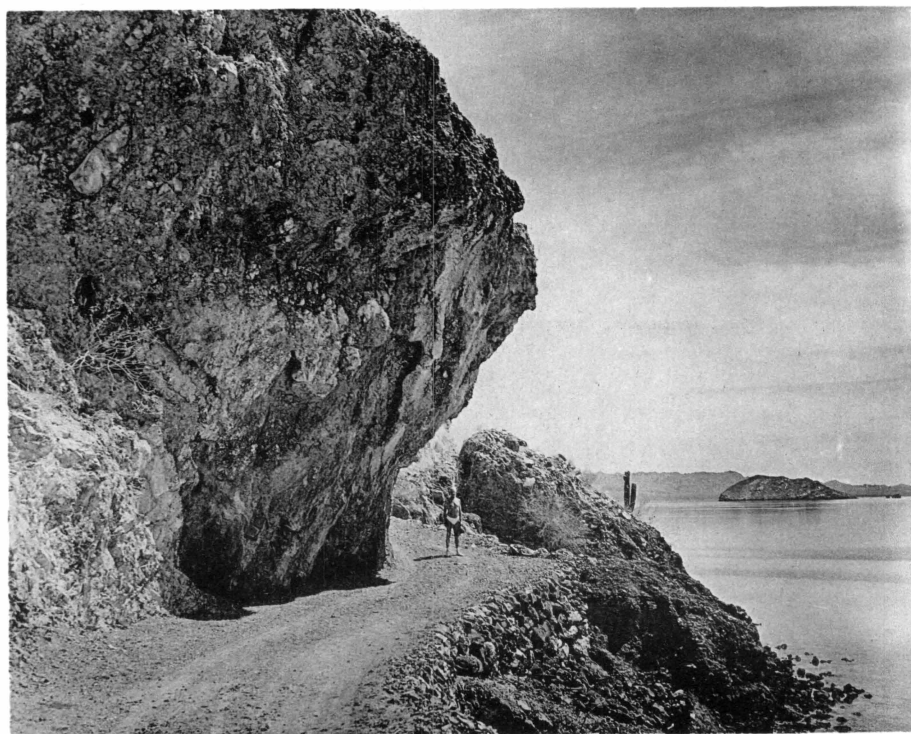


Fig. 100 Road from Mulege to La Paz, western shore, Concepción Bay, Gulf of California

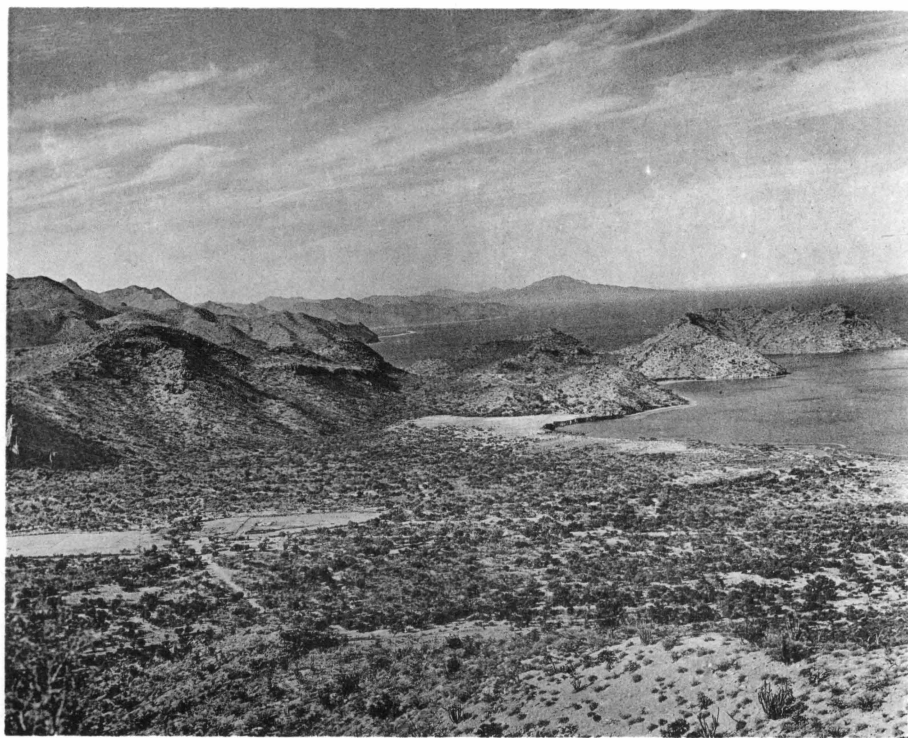
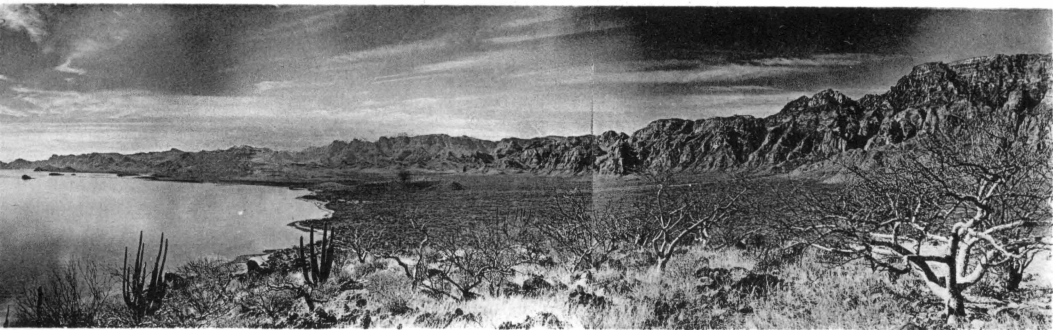


Fig. 101 Puerto Escondido, looking north, Gulf of California

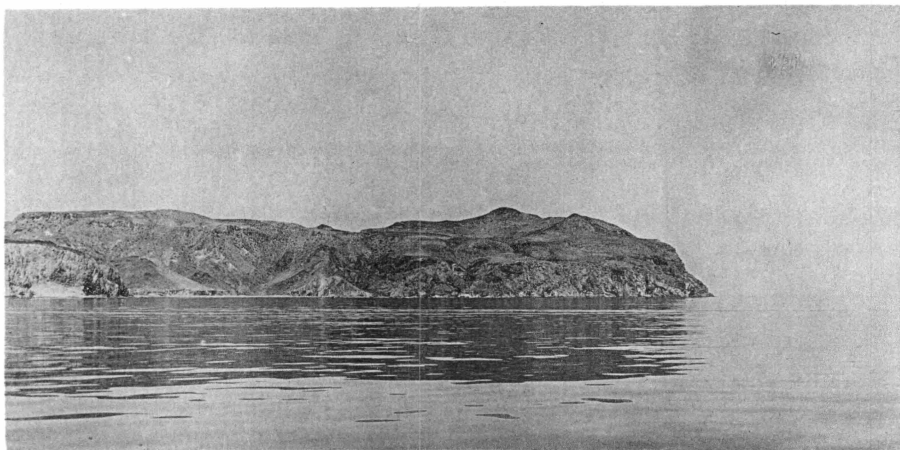


Fig. 102 San Marcos Island, Gulf of California



Fig. 103 Tortuga Island, Gulf of California

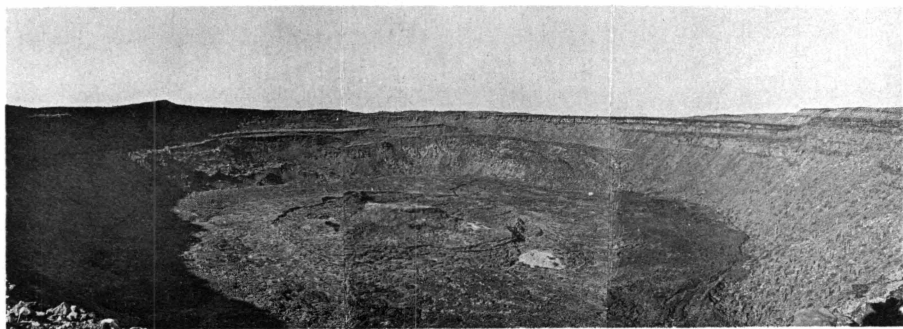


Fig. 104 Crater, Tortuga Island, Gulf of California

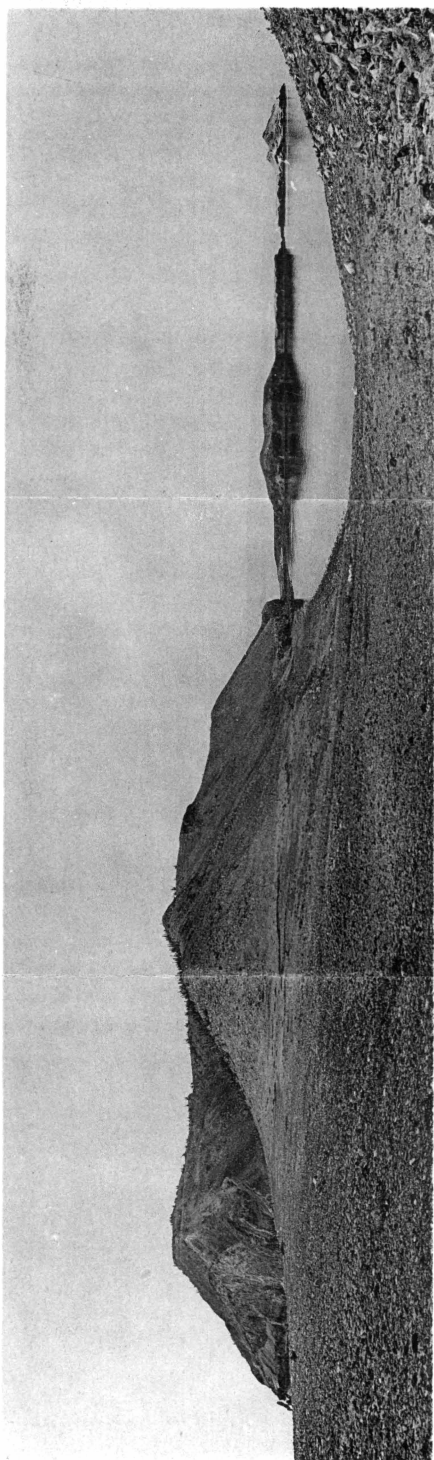
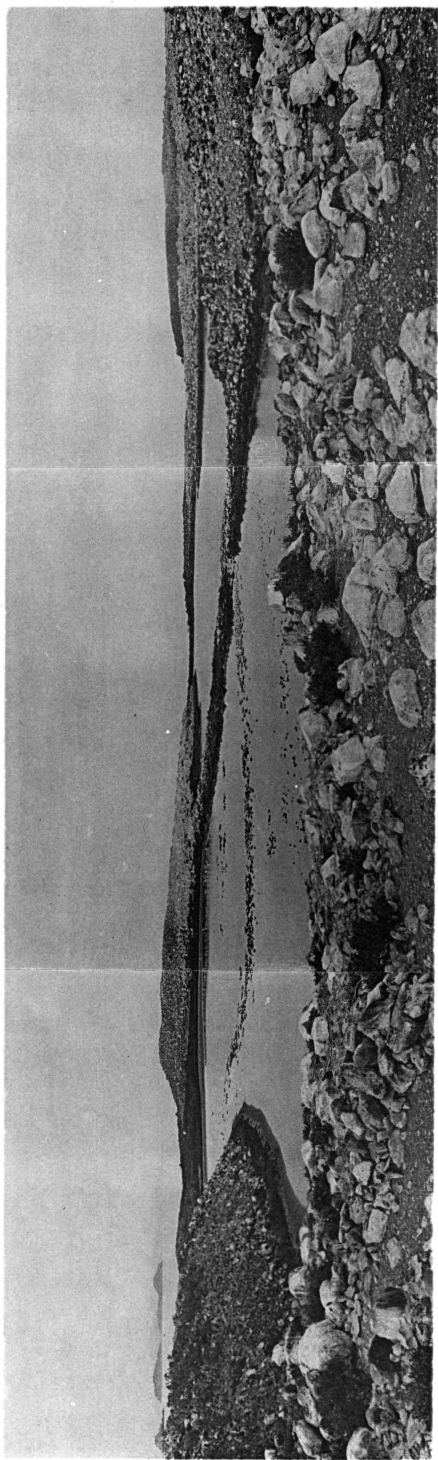


Fig. 105 (*above*) Isla Raza, Gulf of California, looking northward
Fig. 106 Isla Partida, Gulf of California

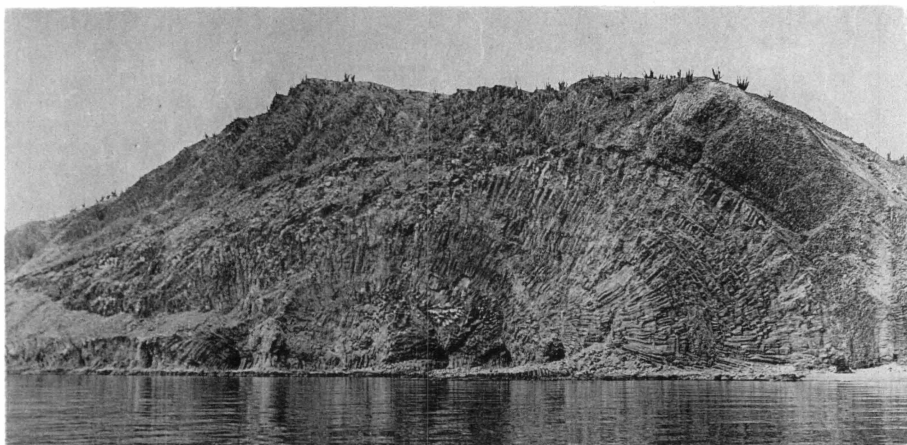


Fig. 107 Basaltic columns, Isla Partida, Gulf of California



Fig. 108 San Francisquito Bay, Gulf of California



Fig. 109 San Francisquito Bay, Gulf of California



Fig. 110 Angel de la Guardia Island, from Granite Island



Fig. 111 Puerto Refugio, Angel de la Guardia Island



Fig. 112 Puerto Refugio, Angel de la Guardia Island, looking west



Fig. 113 Reef at Puerto Refugio, Angel de la Guardia Island

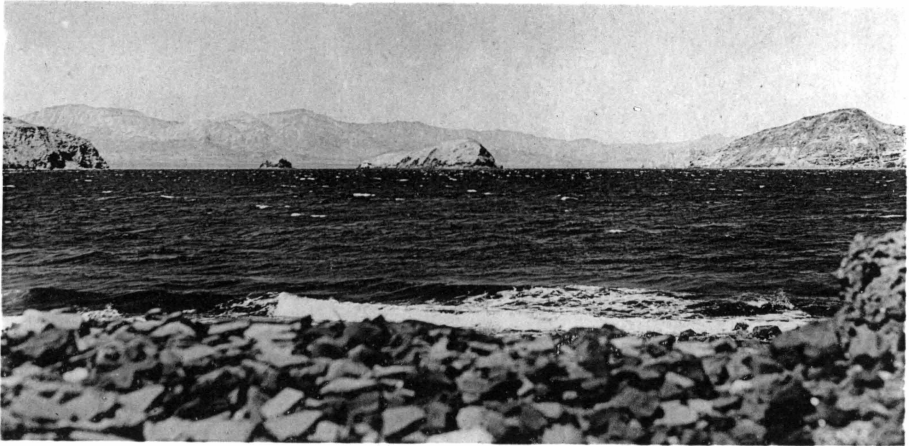


Fig. 114 Entrance Angeles Bay, Gulf of California

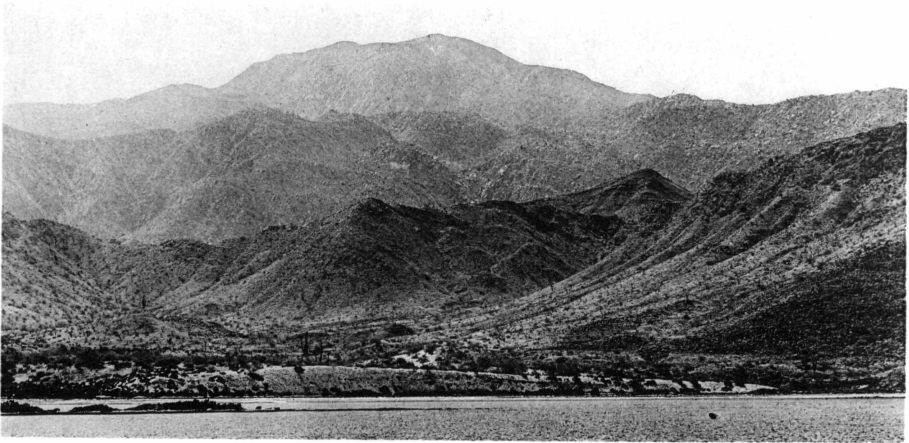


Fig. 115 Round Top Mountain behind Angeles Bay

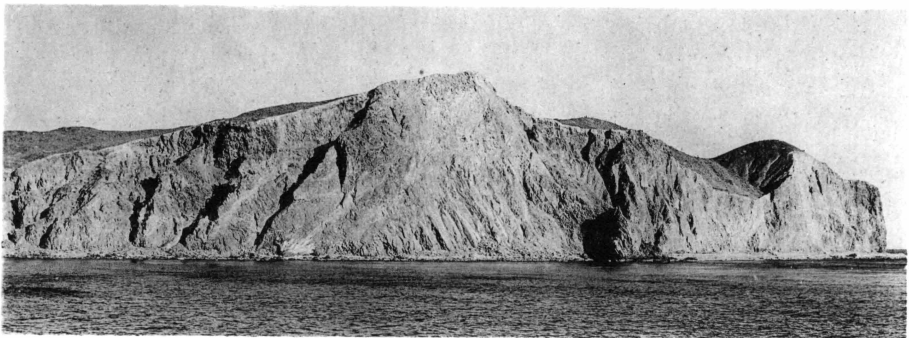


Fig. 116 Pond Island, Gulf of California

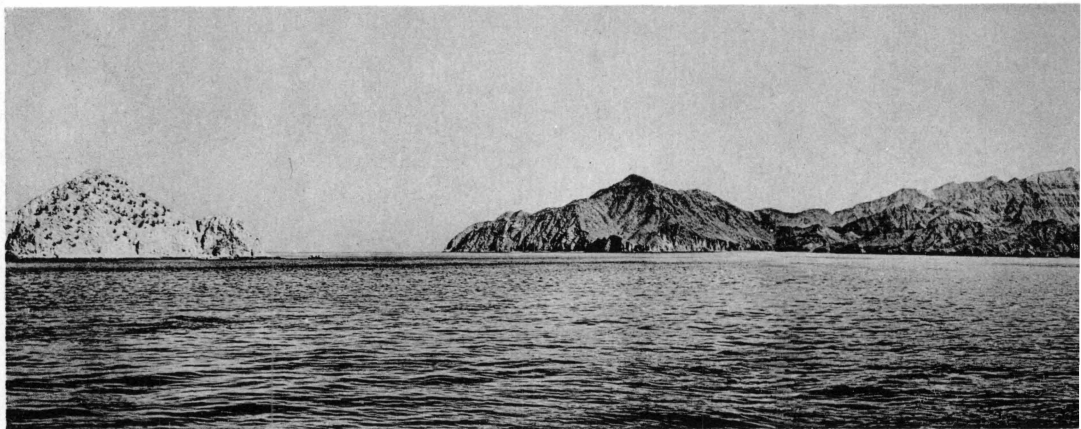


Fig. 117 Panorama, Angel de la Guardia Island, north end

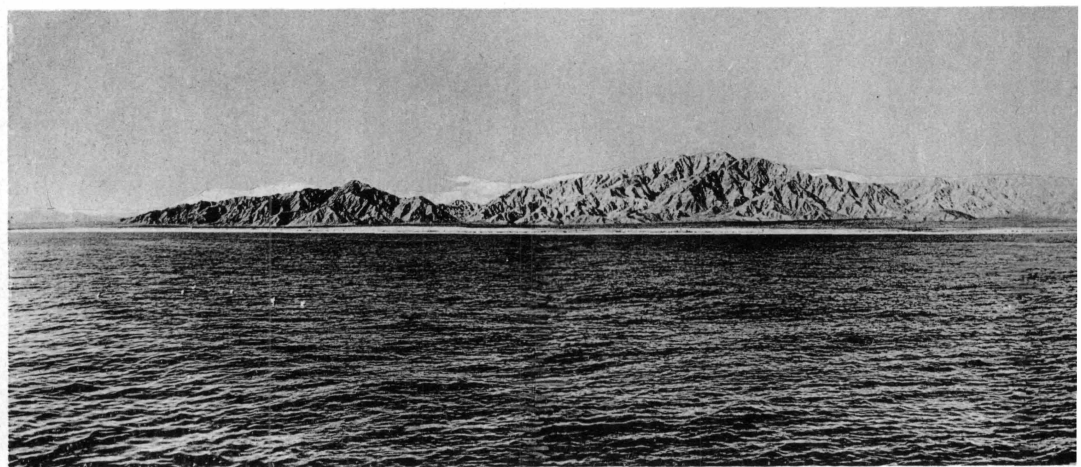
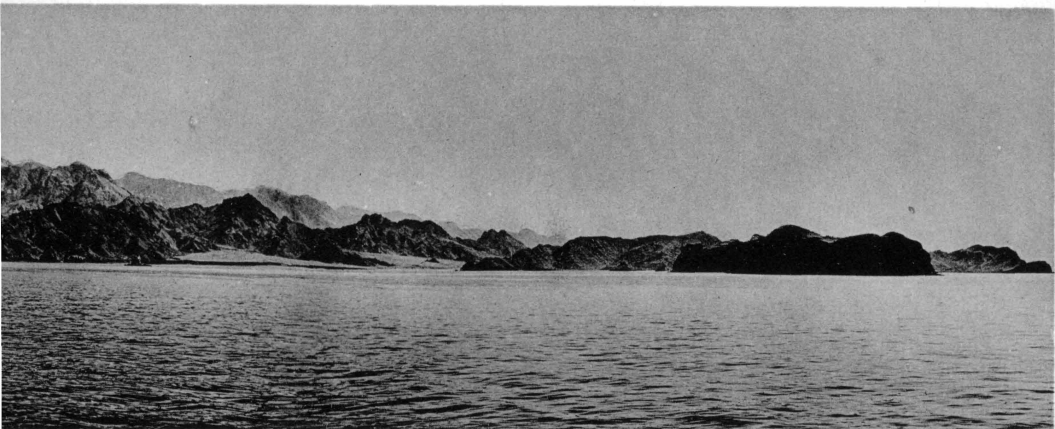


Fig. 118 Panorama, San Felipe Bay, Gulf of California



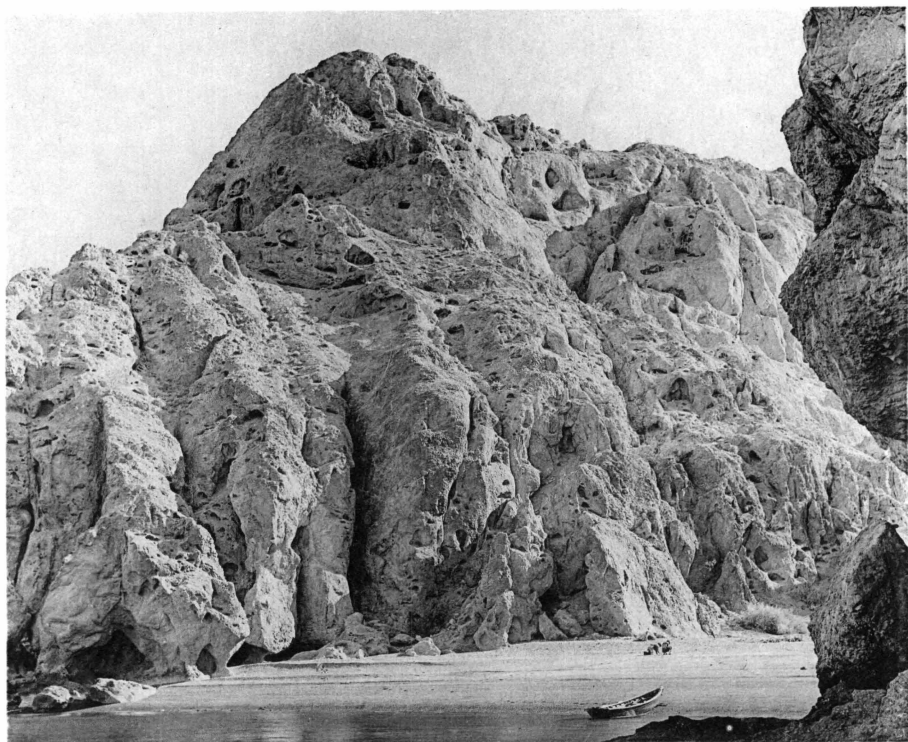


Fig. 119 Angel de la Guardia Island, mountain of pumice

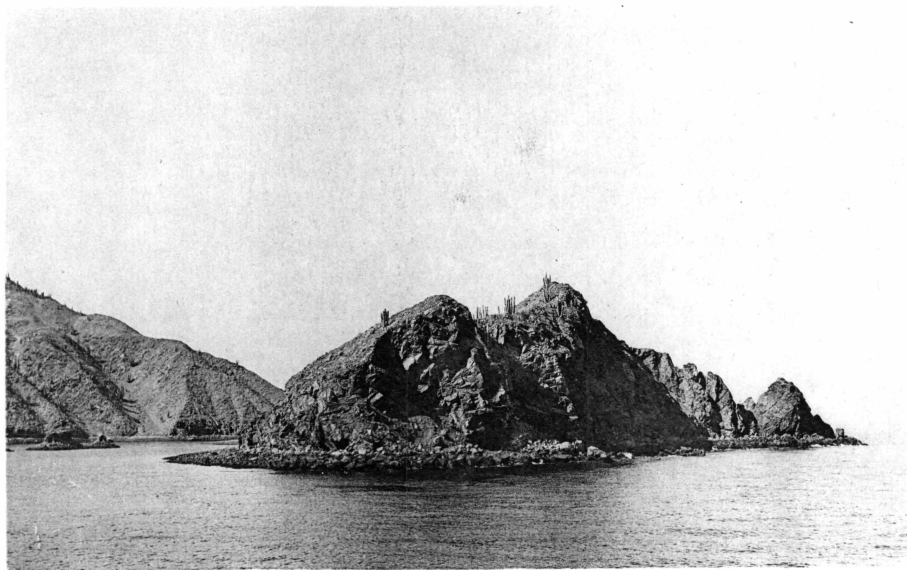


Fig. 120 Islet of Puerto Refugio Bay, Angel de la Guardia Island



Fig. 121 Gonzaga Bay, Gulf of California



Fig. 122 San Luis Island, north of Gonzaga Bay

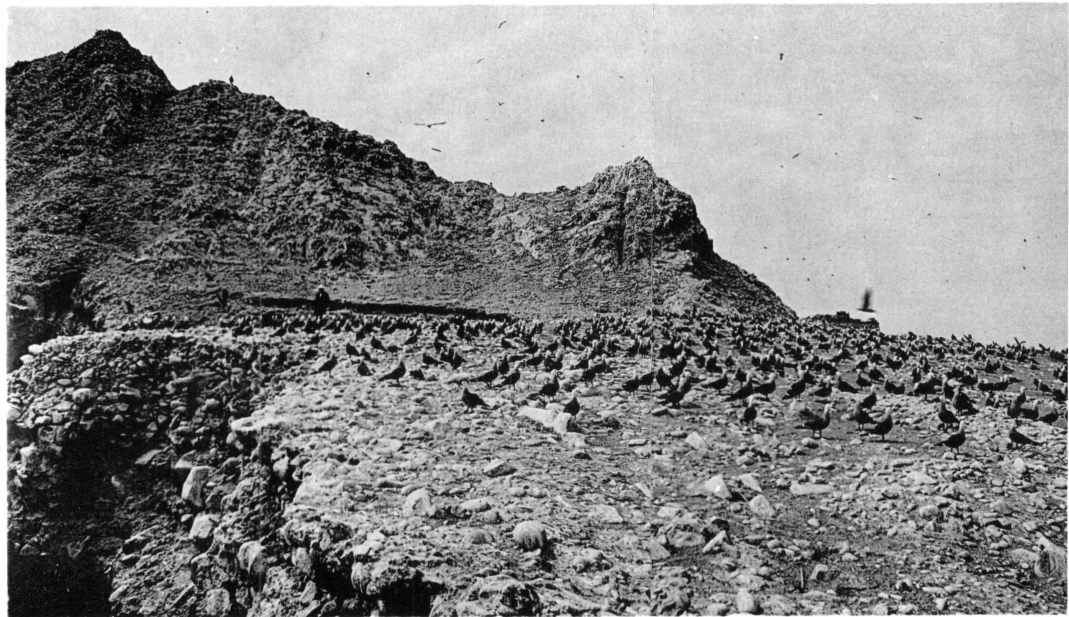


Fig. 123 Panorama of nesting colony Heerman Gulls, George's Island

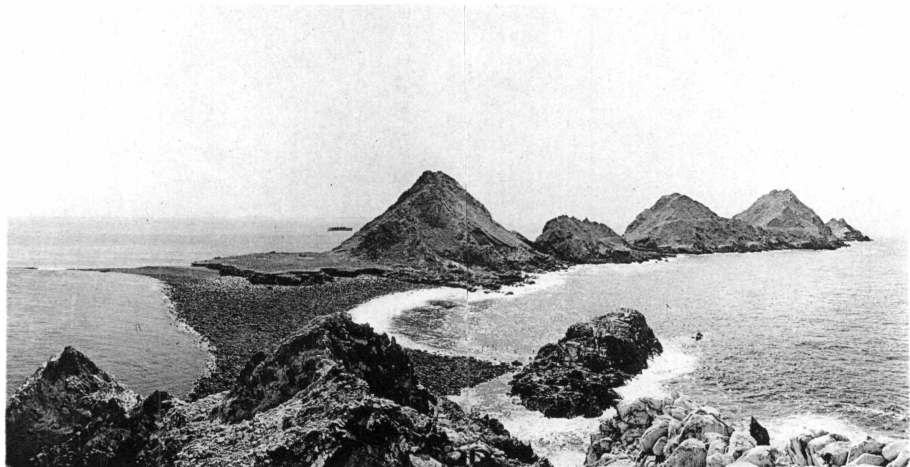


Fig. 124 George's Island from NW

Fig. 125 (*right*) George's Island, sea stacks



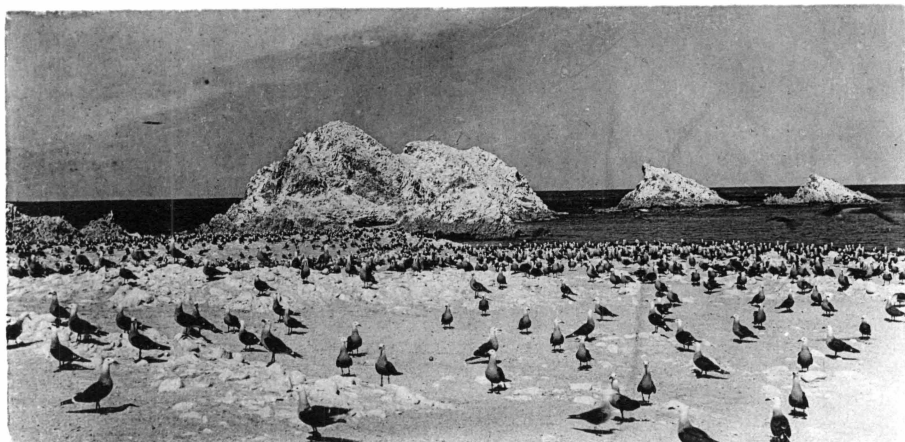


Fig. 126 Heerman gulls, George's Island

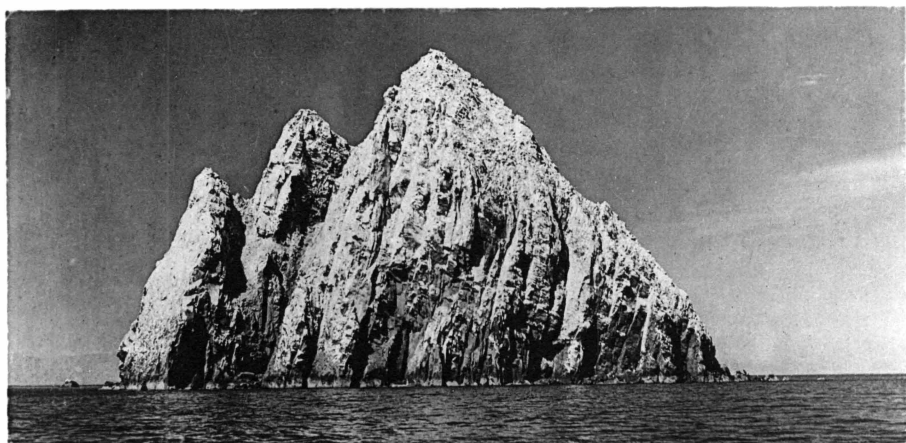


Fig. 127 Consag Rock, Gulf of California



Fig. 128 Rocky Point, Sonora, Mexico

PLATE 49

- Fig. 105 Isla Raza, Gulf of California, looking north toward Isla Partida and Angel de la Guardia Island, which are shown in the left background. The pools in the foreground have been artificially built for the culture of oysters.
- Fig. 106 Isla Partida, showing the western half of the island as viewed from the eastern half. The inlet at the right and a corresponding indentation to the left of the picture divide the island opposite the low isthmus shown in the foreground, so that from a little distance it resembles two islands. Chart 59, p. 400.

PLATE 50

- Fig. 107 Unusual geologic formation at Isla Partida, Gulf of California. The columnar basalt shows cooling from a series of centers. The water in the foreground is deep, the illusion of shallowness being given by reflections of the rock mass.
- Fig. 108 A number of planed terraces are seen in this photograph, taken at San Francisquito Bay, Gulf of California. The arm of the bay shown in the foreground is subject to extreme rise and fall of tidal level, since it is located opposite the narrow Sal Si Puedes Channel. Chart 58, p. 399.
- Fig. 109 San Francisquito Bay, Gulf of California, is located just below San Francisquito Point, which in turn is located opposite San Lorenzo Island, across the famed Sal Si Puedes Channel, the swift current of which was much feared in the days of small sailing vessels.

PLATE 51

- Fig. 110 View of Angel de la Guardia Island from Granite Island, located in Puerto Refugio. A flock of pelicans may be seen along the edges of the rocky spit which extends into the bay. Chart 59, p. 400.
- Fig. 111 Puerto Refugio, Angel de la Guardia Island, has many arms extending among the low-lying foothills of the mountain chain arising in the background. The beach in the foreground shows clearly the 12-foot rise and fall of tide which continually alters the relative proportions of land and sea.

PLATE 52

- Fig. 112 Puerto Refugio, Angel de la Guardia Island, seen from a hilltop located on the east side of the bay. The series of rocky spits extending into the bay are all part of the same bed of hard rock which underlies the softer deposits. The mainland of Lower California can be distinguished in the far distance.
- Fig. 113 Reef at Puerto Refugio, Angel de la Guardia Island, a favorite collecting ground for the marine zoologists. It is the result of a tilted bed of hard rock which has withstood the weathering that has reduced the softer formation.

PLATE 53

- Fig. 114 The entrance to Angeles Bay, Lower California, is guarded by several small islets, two of which are shown in the center of the picture. Much profitable dredging was accomplished by the small dredge boat in this vicinity. (See pls. 13, 14.)
- Fig. 115 Round Top Mountain, elevation 3,423 feet, rises behind Angeles Bay, Lower California. An alluvial fan, cut by wave action, is shown in the foreground.

- Fig. 116 Pond Island, Gulf of California, seen from the deck of *Velero III*. The island lies to the south of Angel de la Guardia Island and encloses a large lagoon in which rock oysters are found. Chart 59, p. 400.

PLATES 54, 55

- Fig. 117 (A panorama.) A view of the north end of Angel de la Guardia Island, Gulf of California, showing Granite Island on the left, Mejia Island on the right, and the entire bay of Puerto Refugio between them.
- Fig. 118 (A panorama.) San Felipe Bay, seen from the east. In the extreme distance rises the mountain range which forms the backbone of the Lower California peninsula and culminates in Mt. San Pedro Martir, elevation 10,000 feet, opposite San Felipe Bay. Chart 63, p. 402.

PLATE 56

- Fig. 119 A mountain of pumice, located on the east side of Angel de la Guardia Island, Gulf of California. Pieces of this rock will float when placed in water.
- Fig. 120 A nameless islet in Puerto Refugio Bay, Angel de la Guardia Island, Gulf of California.

PLATE 57

- Fig. 121 A perfect spit separates the lagoon in the background from Gonzaga Bay (shown in the left foreground). In the right foreground is the narrow channel which lies between the tip of the sand spit and the rocky promontory from which the photograph was taken. The lagoon is a favorite stopping place for migratory birds.
- Fig. 122 The island of San Luis, located north of Gonzaga Bay in the Gulf of California, is composed entirely of a soft gray sandstone which shows beautiful bedding.

PLATES 58, 59

- Fig. 123 Nesting colony of Heerman gulls at George's Island, Gulf of California. The site chosen by the birds is an ancient alluvial fan. No eggs had yet been laid at the time the picture was taken.
- Fig. 124 George's Island, seen from the northwest. *Velero III* may be seen in the distance directly above the remnants of an old alluvial fan. The reef in the foreground is awash at high tide.
- Fig. 125 Marine biologists collecting on a reef which extends between two of the series of sea stacks which comprise George's Island, Gulf of California.

PLATE 60

- Fig. 126 Heerman gulls nesting on the remnants of an ancient alluvial fan at George's Island, Gulf of California.
- Fig. 127 Consag Rock, a conspicuous landmark for vessels setting a course to the mouth of the Colorado River. It is of basalt, the columns showing almost vertical jointing, and rises from the otherwise muddy floor of the upper Gulf to a height of 285 feet. Chart 63, p. 402.
- Fig. 128 Rocky Point, Sonora, was the northernmost locality visited by *Velero III* on the east side of the Gulf of California. It is the terminus of an almost impassable road leading across the desert from southern Arizona. Chart 64, p. 402.

Gulf of California—East Coast

Plates 60-64; Charts 63-69

On the east coast of the Gulf of California, the *Velero III* has not proceeded farther north than Rocky Point. From this point to the mouth of the Colorado River the coast has been described by the *Coast Pilot* thus:

Beyond Shoal Point, the eastern entrance point of the Colorado River, the coast, trending east-southeastward for a distance of 10 miles, is generally low, with here and there a sandhill of moderate height. Shoal water extends off shore to distances increasing from $\frac{1}{2}$ mile, near Shoal Point, to 2 miles, at a position 10 miles farther east-southeastward.

Adair Bay is a wide indentation that is entirely open to the southward, and is so filled with dangerous shifting shoals as to be impracticable for even the smallest coasters. Its western limit lies 10 miles east-southeastward of Shoal Point, and Rocky Bluff, the eastern limit, lies $35\frac{1}{2}$ miles in the same direction from that point. The coast recedes 10 miles from a line drawn between these two points. The shore of the bay is low and sandy, with occasional rocky patches. Opening into the northern part is a lagoon, at the entrance to which there are several drying sandspits that project out 2 or 3 miles into the bay. Low plains with surface deposits of soda extend far into the interior. Spring tides rise about 22 feet.

From the bold Rocky Bluff the coast turns eastward for 5 miles to Rocky Point, the stretch between being Rocky Point Bay, with a sandy shore. There are dredging stations off Rocky Bluff and in Rocky Point Bay, 4-12 fathoms, sand and mud, at one of which basketstars were obtained.

From Rocky Point the coast turns almost directly eastward for 22 miles and then southward to form the wide open Georges Bay, about 26 miles from point to point, with low, sandy shore. Lying 7 miles offshore from the southern extremity of the bay is a high, barren rock, white with guano, Georges Island, with small outlying rocks. On portions of the shore there are large individual rocks, so that the shore might be described as a very coarse shingle. Here some collecting has been done, and there are dredging stations near the island.

From the southern extremity of Georges Bay the coastal trend is almost directly southward for more than 20 miles, when it gradually swings eastward past the mouth of the San Ignacio River, 32 miles from the southern extremity of Georges Bay, and then southward again to Cape Tepoca, 18 miles from the mouth of the river. The northern part of this coast is low and sandy, but the southern part is not so low. Cape Tepoca is high near the tip, but lower farther back. A low, rocky point

extends $\frac{1}{2}$ mile southeastward to be continued as reef for some distance farther. The point and reef form the western limit of Tepoca Bay, $2\frac{1}{2}$ miles across, the western portion of the shore being low and sandy, but the eastern with sand bluffs. Shore collecting has been done on the point and on the reef, and dredging in the bay.

From Cape Tepoca the coast turns eastward and then southward again to Cape Lobos, 23 miles distant. The sand cliffs extend for some distance, to be followed by a low, sandy shore. Cape Lobos is similar to Cape Tepoca, sheltering Libertad Anchorage in the same way that Cape Tepoca shelters Tepoca Bay. There are one shore station at Cape Lobos and two dredging stations offshore to the northwest.

From Libertad Anchorage, the coast continues in a southeasterly direction for $36\frac{1}{2}$ miles to Cape Tepopa, with much the same type of coast, but with less of a sweep than in the two previous bays. Like the other two points, Cape Tepopa is a bold, rocky headland. Six and a half miles farther on in the same general direction is Sargents Point, also high and rocky, but it is connected with the mainland by a low, narrow neck of land that may be submerged at high tide. West of this point, $5\frac{1}{2}$ miles, lies Patos Island, which, except for a conical hill in the northwest portion, is low. It, also, is white with guano. Collections of plants and insects have been made on this island.

From Sargents Point there is another sweep southeastward 20 miles to San Miguel Point, with a much similar coast line. From $2\frac{1}{2}$ to $3\frac{1}{2}$ miles off this part of the coast lies the northern half of the largest island in the Gulf of California, Tiburon Island, with the northern extremity 4 miles south of Sargents Point. It is high and rugged but not so barren as other islands in the Gulf, with a length north and south of 29 miles and an average width of 15 miles. It is nearly rectangular, but the east side is somewhat longer than the west. The north and much of the east coast are low and sandy, but the remainder is bolder and more rocky. Only the shore at the southeast corner is much broken.

The southeast point of the island, not named on the chart, is a high headland at the extremity of a peninsula that forms a bay, well protected from the southeast winds. To the westward of this point, 3 miles, separated from it by a narrow bay with a sand beach, is Monument Point, the most southerly point of the island. Off this bay are Turners Island, $1\frac{1}{4}$ miles by $\frac{1}{2}$ mile, Seal Rocks, and several other rocks and reefs. Another small bay separates Monument Point from Red Bluff Point, $2\frac{1}{2}$ miles westward. West of Red Bluff Point, the coast again becomes regular.

Only the vicinity of the southeastern extremity of the island has been explored, on both sides of the extreme southeastern point and around Turners Island, shore collecting on sand, rock, shingle, and reef, dipping, seining, and much dredging—almost wholly in shallow water.

Lying $7\frac{3}{4}$ miles south of Willards Point, the western extremity of Tiburon Island, is a barren, rocky island, 4 miles by 3 miles, Esteban Island, with plenty of coastal variety, rocks, reefs, gravel, shingle, and a sandspit (to the southwest). There have been shore collecting along the south shore and dredging to the east and southeast of the island.

From San Miguel Point southeastward to Point San Antonio, a distance of 90 miles, there are no significant coastal features. The coast is still low and sandy, and the water is shallow for a long distance from shore, but rocky bluffs, not very high ones, appear more often than farther north. The bluffs are continuous enough for 5 to 10 miles northwest of Point San Antonio to form a rugged coast for this short distance.

Directly west of Point San Antonio, 15 miles, and 8 miles from the nearest Sonora mainland is the barren, rocky, volcanic islet, San Pedro Nolasco Island, $2\frac{1}{4}$ miles long, $\frac{3}{4}$ mile wide. The coast is largely inaccessible. Off the southern end there are detached rocks, but elsewhere the water is deep close to shore. Some land plants have been collected on the island, and dredging has been done to the east and the northeast, in 45 to 110 fathoms.

The shore for some distance east of Point San Antonio becomes much higher and more rugged. The mountain peaks are nearer the coast, and the coast line is much more broken with numerous small indentations, projecting points, and small islands. East of Point San Antonio $2\frac{1}{2}$ miles is Punta Doble, forming the western extremity of a large open bay, Ensenada San Francisco, the shore of which sweeps eastward and then southward to Cabo Arco, the southeastern extremity, 7 miles from Point Doble. There are several secondary inlets, of which Puerto San Carlos, nearer the northwestern end of the bay, affords the best shelter. Most of the collecting in Ensenada San Francisco has been done in or near Puerto San Carlos, shore collecting on rock and shingle, dipping, seining, beam trawling, and dredging.

From Cabo Arco the coast extends slightly south of east, in a series of three bights, to Cabo Haro, 4 miles away. Cabo Haro is the southern point of a peninsula that shuts off the inner harbor of Guaymas from the open Gulf and forms the western boundary of the outer harbor and the southern boundary of the middle harbor. The west face of this peninsula

extends irregularly 4 miles from Cabo Haro to Punta Baja. The most protected inlet is Bahía Catalina, $1\frac{1}{2}$ miles from Cabo Haro, where shore collecting on shingle and dredging in and outside the bay have been carried on.

The outer harbor is shut off from the Gulf by the Isla de Pajaros and from La Laguna, an extensive body of water lying to the northward, by the long, narrow spit from the east shore, Playa de los Dolores. The outer harbor is wide open to the middle harbor, but the middle harbor is somewhat closed off from the inner harbor by islands and peninsulas, between which, however, there is a clear passage. The outer harbor is suitable for anchorage of large ships, but the middle harbor is shallower, and the inner harbor more so, only suitable for vessels of shallow draft.

The City of Guaymas is situated at the head of a small bay on the northwestern side of the inner harbor.

Some shore collecting on rock and shingle in the middle and inner harbor and one dredging station, in 2-3 fathoms, in the middle harbor cover the activities here.

The rugged hills and mountains, which are conspicuous near the shore in the Guaymas region, do not last for long, but the low-lying shore and immediate background hold sway again for a great distance. From Guaymas Harbor to Ahome Point, approximately 175 miles, through three long, sweeping curves, there is little else than sandy shores, sandy islands, sandy shoals, and sandy lagoons, making it difficult to approach the shore, and with such little variety that it offers little attraction to a marine collector. No collecting has been done anywhere near this part of the coast.

From Point Ahome, the same type of coast extends directly southward for 20 miles to San Ignacio Point, a point on a small island of the same name that lies off a large island, Santa Maria Island, $13\frac{1}{2}$ miles long, one of the many elongated, low islands, separated by lagoons or shallow water areas from the low mainland. The trend of the coast here is eastward; so the long axis of the island lies east and west. Its southern shore forms the boundary of San Ignacio Bay. The east point of the island, Santa Maria Point, delimits, to the westward, Topolobampo Harbor and its northwestern extension, San Carlos Bay.

Lying 13 miles west-southwestward of Santa Maria Point is San Ignacio Farallon, a conspicuous, white, barren rock, 465 feet high.

Shore collecting has been done on the rocks at San Ignacio Farallon, and dredging in San Ignacio Bay, in 3 to 90 fathoms.

Southeast of Topolobampo Harbor the coast is of the same type found throughout the whole State of Sinaloa, so that no collecting has been done for another 175 miles, where there is one dredging station in 6-8 fathoms off Point Piaxtla, which, for a change, forms a rocky headland. Even at Mazatlan, 35 miles farther south, no marine collecting has been done. The *Velero III* called here in December, 1931, but the collecting at this time was all inland collecting.

Although Mazatlan is the largest city on the coast between San Diego and Panama, only the outer harbor is accessible to large vessels. The entrance is between Creston and Chivos islands.

As Mazatlan is nearly directly east of Cape San Lucas, it may be considered to be the southeastern limit of the Gulf of California; but, commonly, Cape Corrientes, 175 miles farther south, is considered to be the limit.

For the first 70 miles from Mazatlan the trend of the coast line continues to the southeast and then turns more nearly southward. For about 100 miles from Mazatlan the coast is similar to that farther north, after which it becomes more bold and rugged and the sandy islands and the lagoons disappear.

Lying 17 miles offshore, 50 miles south of the boundary between Sinaloa and Jalisco and 90 miles north of Cape Corrientes, is Isabel Island, $1\frac{1}{2}$ miles long, $\frac{1}{2}$ mile wide, and 280 feet high, with several rocks or rocky islets offshore. The main island consists of three large crater cones, the half toward the water, in each case, having entirely disappeared. Two of them, in vertical section, have the appearance of lava formation, but the one facing south looks definitely like sandstone. Vegetation is sparse, but there is enough to show up distinctly on the northeastern slope, where it covers the surface quite fully. It is evidently a favorite resort and nesting place for myriads of frigate birds, terns, boobies, and tropic birds. Two of the outlying rocks, close to the northeast point of the island, are conspicuous. One of them is supposed to resemble a swan. The only sand beach is a small one near the southeastern end of the island.

This island has been visited on five occasions for specimens, on land, on sandy and rocky shore, on reefs, dipping near the surface, and on sand, coralline, and nullipore bottom in shallow water, 25 fathoms or less.

Approximately 40 miles to the southwest of Isabel Island are Las Tres Marias Islands. The northernmost island, San Juanito, is a small island, $2\frac{1}{2}$ by $1\frac{1}{4}$ miles, and the three main islands, Maria Madre, Mag-

dalena, and Cleopha, follow in a series to the southeast. The islands are volcanic, with their western sides high, barren, inaccessible cliffs and the sea bottom dropping abruptly into deep water, but with the eastern sides low, sandy, and less barren. From the shores of all the islands there are extensive reefs and outlying rocks.

Maria Madre, 2 miles from San Juanito Island, is the largest, 12 miles long and 3 to 6 wide. A channel, 4 miles wide, separates it from Magdalena Island, the second largest, 8 miles long and $4\frac{1}{2}$ wide, which, in turn, is separated from Cleopha, a nearly circular island, with a diameter of 3 miles, by a channel, $8\frac{1}{2}$ miles wide. There are one shore station on the east coast of Magdalena Island and two dredging stations east of this island.

Port San Blas is situated where the low, sandy shore and low back-country plains change over to the more rugged coast, where the mountains or high hills come much nearer the sea. Sandy beaches do not entirely disappear, but, when they do appear, there are usually rocky bluffs on each side and small islands offshore.

From Port San Blas, the coast turns eastward, then southward and southwestward to Punta Mita, 50 miles away, from which it turns abruptly eastward again to form the northern boundary of a 20-mile deep indentation, Banderas Bay, 15 miles across, with the southwestern limit at Cape Corrientes.

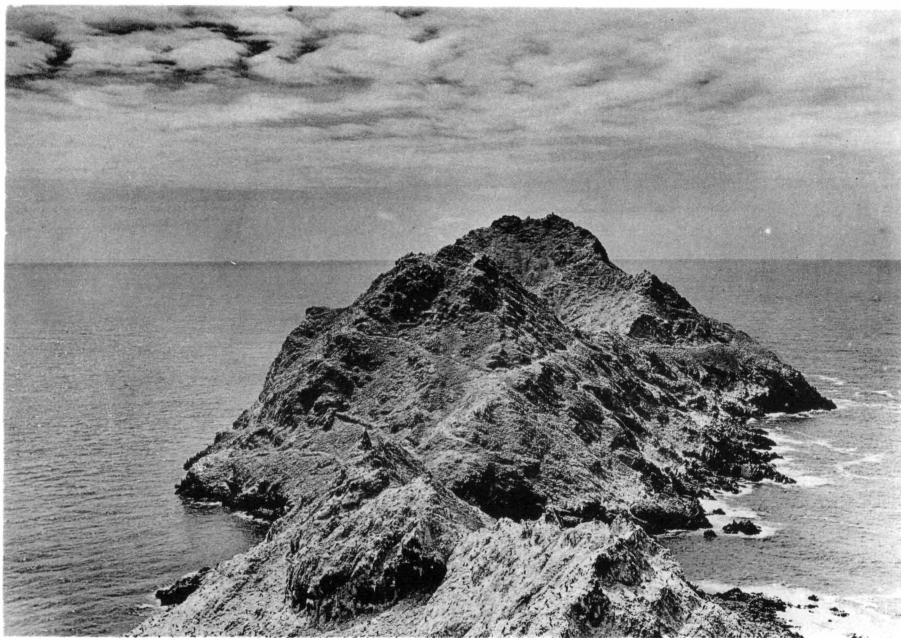


Fig. 129 George's Island, Gulf of California



Fig. 130 Tiburon Island, Gulf of California

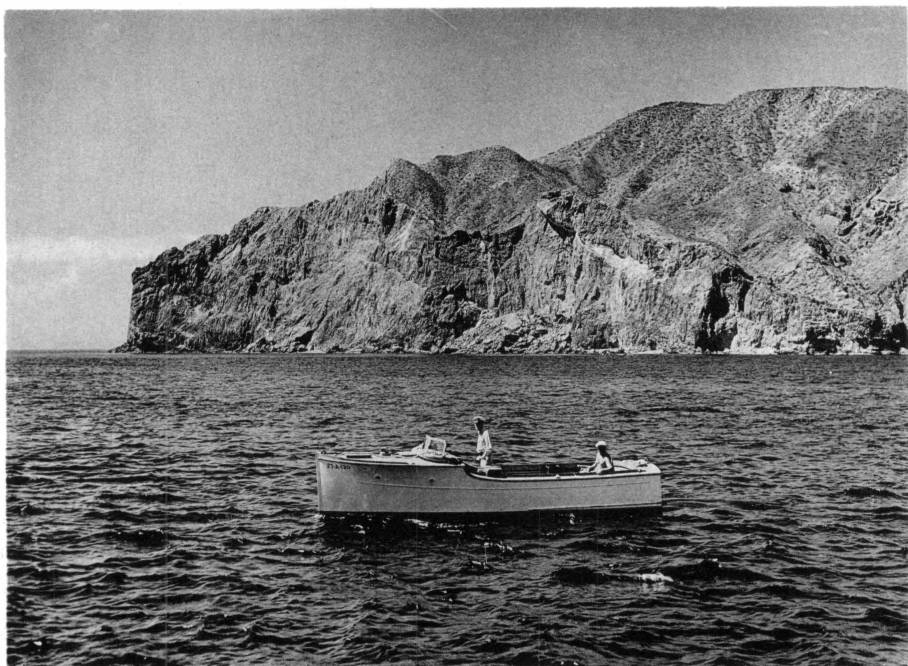


Fig. 131 San Esteban Island, south shore

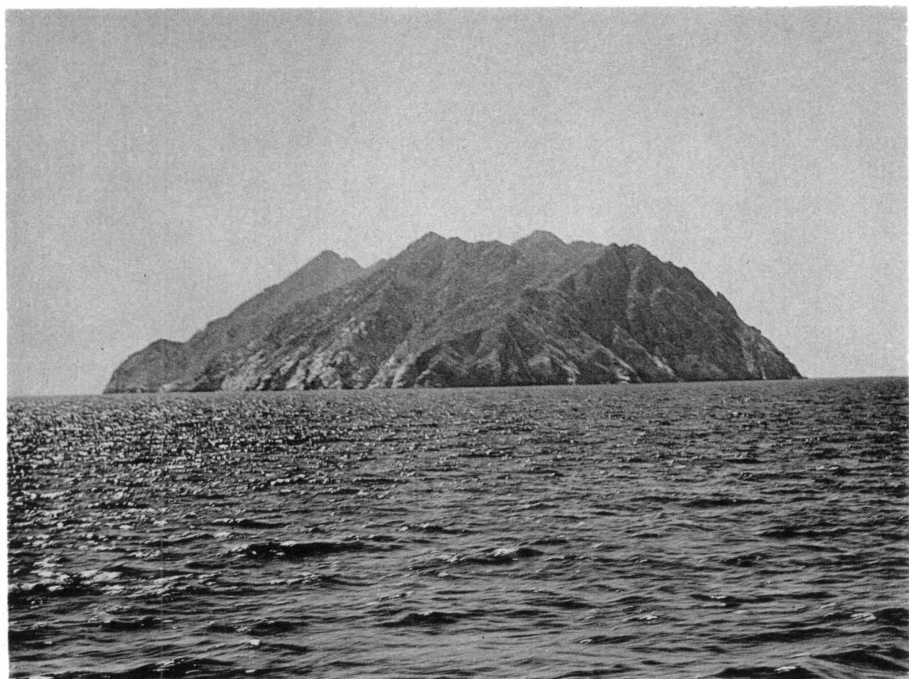


Fig. 132 San Pedro Nolasco Island

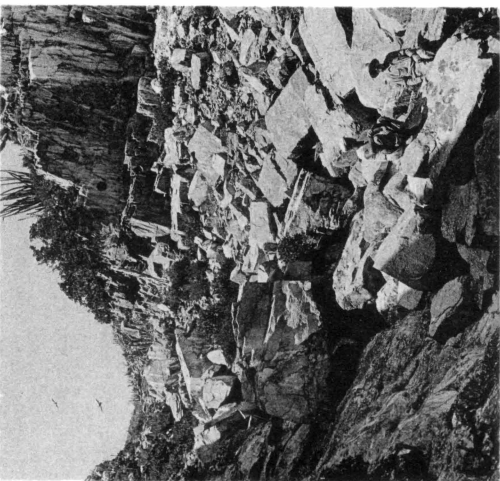
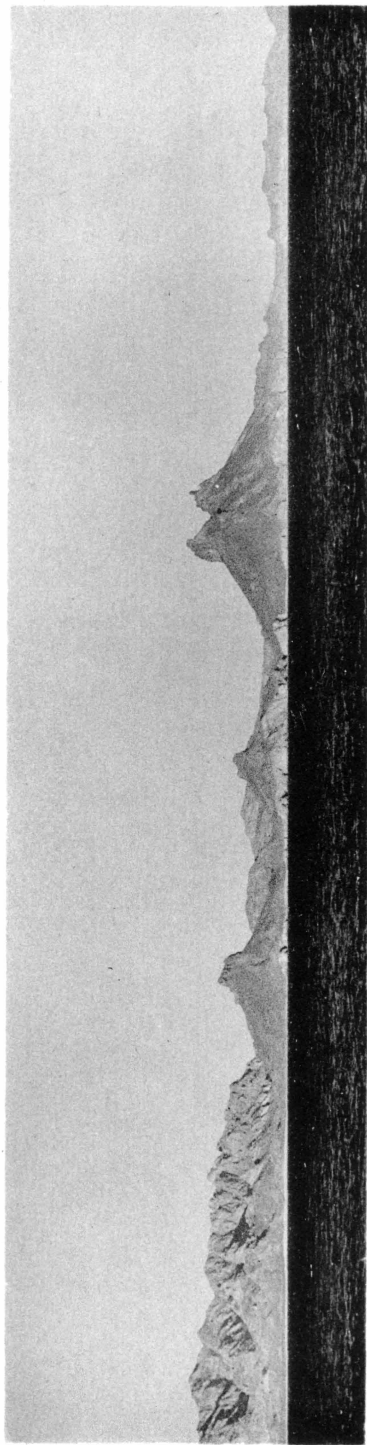
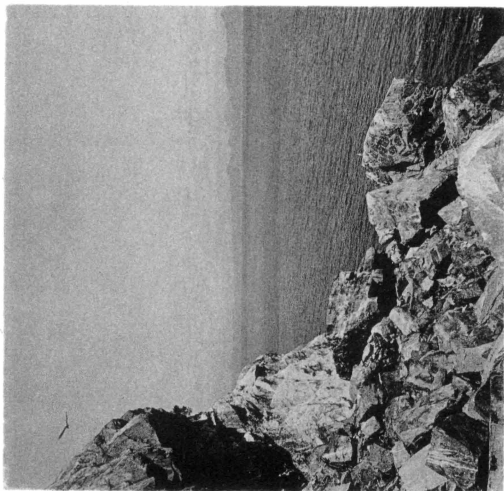


Fig. 133 (*left*) San Pedro Nolasco Island

Fig. 134 (*right*) Sonoran mainland from San Pedro Nolasco Island

Fig. 135 (*below*) Sonoran coast line, north of Guaymas



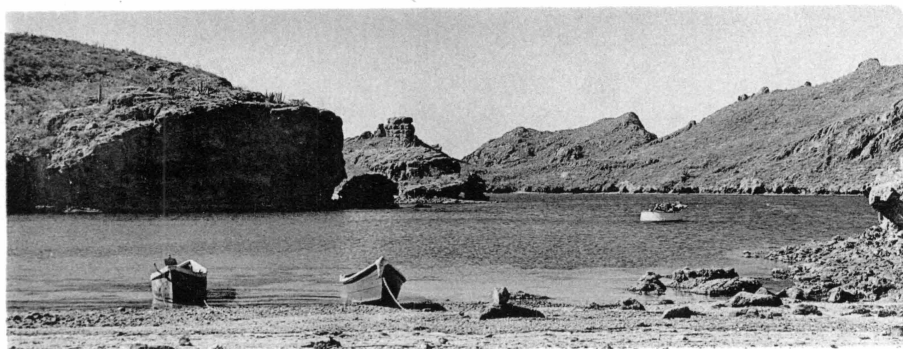


Fig. 136 Puerto San Carlos

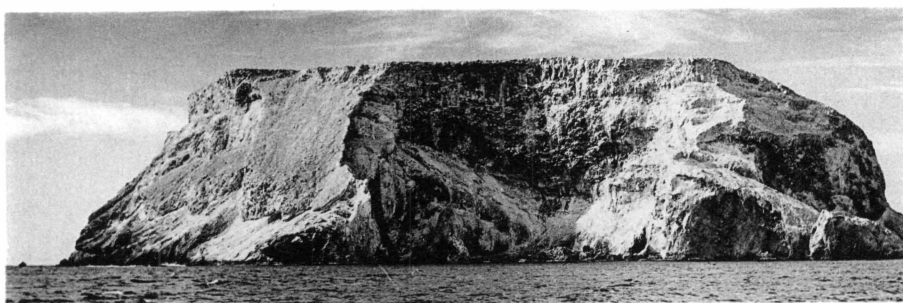


Fig. 137 San Ignacio Farallon

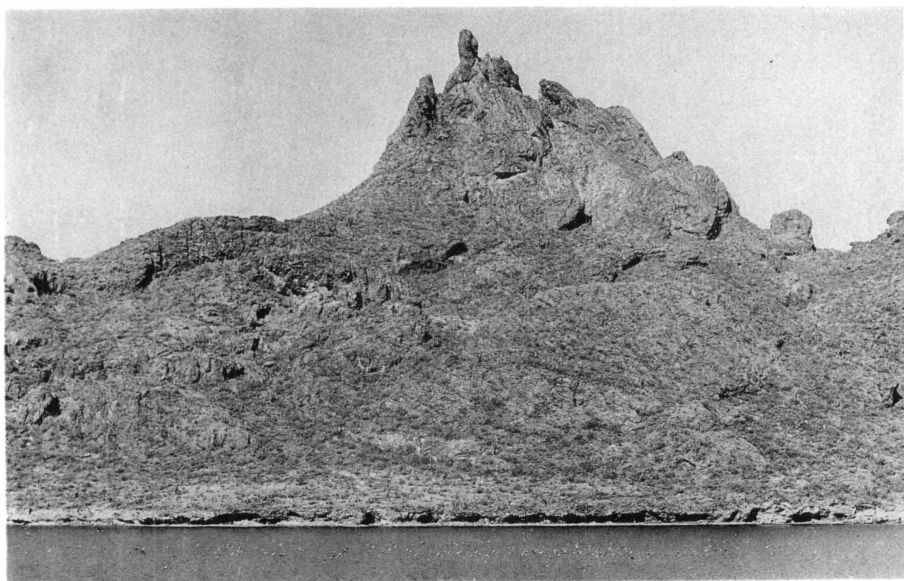


Fig. 138 Puerto San Carlos, *las tetas de cabra*

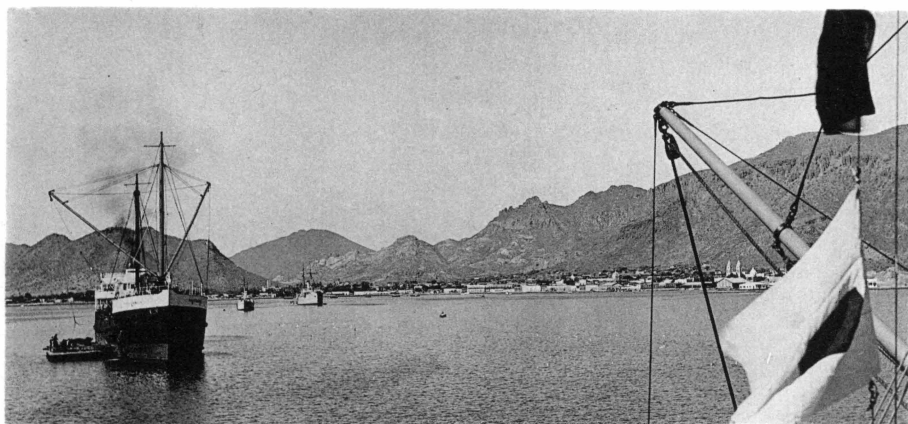


Fig. 139 Guaymas Harbor, Mexico



Fig. 140 Mazatlan, Mexico

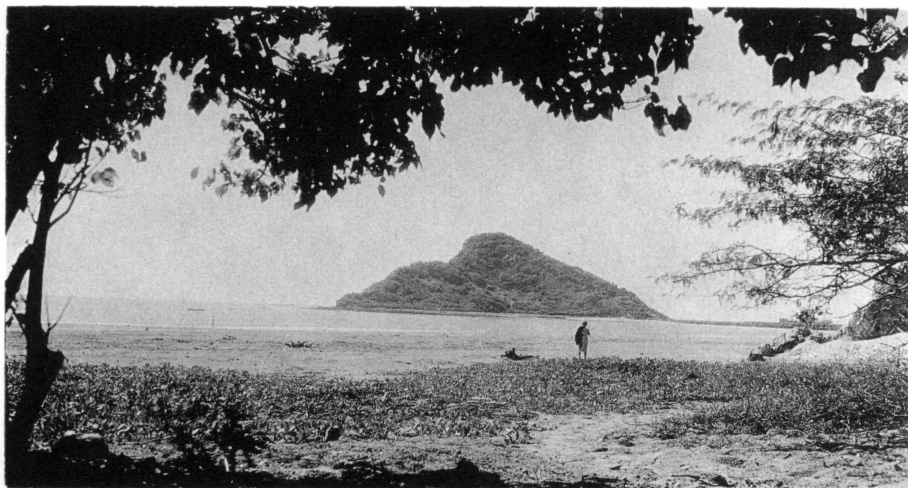


Fig. 141 Mazatlan, Mexico, beach south

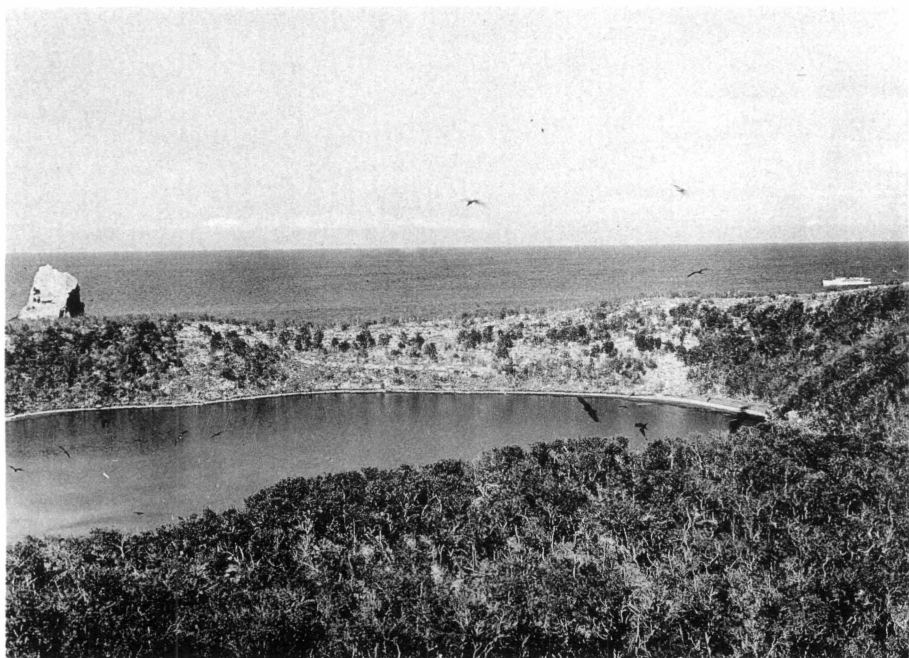


Fig. 142 Crater Lake, Isabel Island, Mexico



Fig. 143 Isabel Island, Mexico, reef

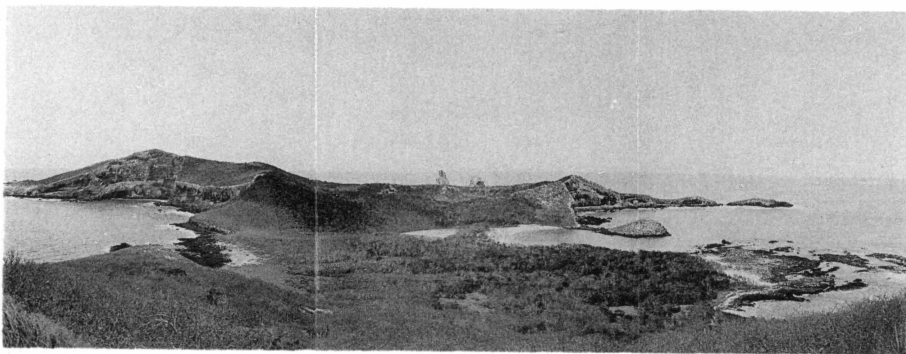


Fig. 144 Panorama, Isabel Island



Fig. 145 Reef, Isabel Island



Fig. 146 Isabel Island, beach

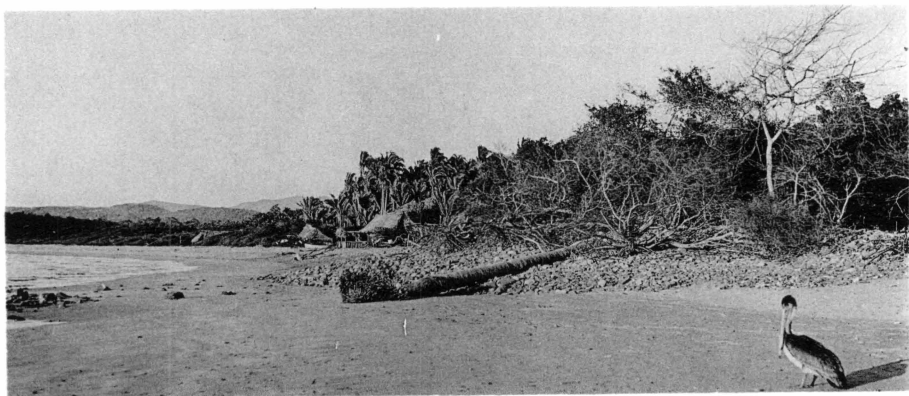


Fig. 147a Tenacatita Bay, Mexico



Fig. 147b Navidad Head from Tenacatita Bay

PLATE 61

- Fig. 129 George's Island, Gulf of California, is the nesting site of thousands of Brewster's boobies and lesser numbers of red-billed tropic birds. Chart 64, p. 402.
- Fig. 130 A quiet inlet on the southeast shore of Tiburon Island, Gulf of California, home of the nomadic tribe of Seri Indians. A dwarf species of deer is said to occur on the island, which is exceedingly barren, mountainous, and with no apparent sources of fresh water. Chart 66, p. 403.

PLATE 62

- Fig. 131 The south shore of San Esteban Island shows a type of undercutting by wave action which is characteristic of the unprotected shores of the Gulf of California. The ship's launch is shown in the foreground. Chart 66, p. 403.
- Fig. 132 San Pedro Nolasco Island is located in the Gulf of California north and west of Guaymas. There are few landing places on its steep granite slopes. It is inhabited largely by pelicans, boobies, and rock iguanas. Chart 67, p. 403.

PLATE 63

- Fig. 133 One of the several boulder-strewn canyons which rise precipitously from the eastern shore of San Pedro Nolasco Island, Gulf of California.
- Fig. 134 Mainland of Sonora, Mexico, seen from the shores of San Pedro Nolasco Island, Gulf of California.
- Fig. 135 The Sonora coast line north of Guaymas is exceedingly irregular. Perhaps no landmark in the entire Gulf is more distinctive than *las tetas de cabra* shown above the ship's telegraphic control.

PLATE 64

- Fig. 136 Puerto San Carlos, a small landlocked bay in the vicinity of Guaymas, Sonora, affords ideal protection to small vessels. *Velero III* anchored outside in the larger Ensenada de San Francisco.
- Fig. 137 San Ignacio Farallon is located in the southern portion of the Gulf of California about 18 miles from Topalobampo Harbor. (Like Consag Rock, it seems to bear no relation to its surroundings, the mainland territory being low and sandy.) Expedition members scaled the summit and found thousands of nesting sea birds, including tropic birds and Brewster's boobies. Chart 68, p. 403.
- Fig. 138 The *las tetas de cabra* is a particularly eroded pinnacle located within sight of Guaymas, Sonora. Hancock Expedition scientists scaled all but the topmost pinnacle on two separate occasions. Chart 13, p. 371.

PLATE 65

- Fig. 139 Panoramic view of the harbor at Guaymas, Sonora, showing cargo vessels in the foreground and the city in the middle distance. The boat landing is to the left of the cathedral spires shown above the lowest of the signal flags. Chart 13, p. 371.
- Fig. 140 Beach at Mazatlan, Mexico, just west of the harbor, showing breakwater extending to Chivos Island in the center, in back and to the right of which a freighter may be seen. Chart 13, p. 371.
- Fig. 141 Entrance to the harbor at Mazatlan, Mexico. The lighthouse is perched upon Creston Island at the right, fully 500 feet above the surface of the sea.

PLATE 66

- Fig. 142 Crater Lake at Isabel Island, Mexico, showing one of the sea stacks at the left and *Velero III* at the right. The forest of low trees in the foreground is occupied by nesting man-o'-war birds. Chart 69, p. 404.
- Fig. 143 Wave-worn coast of Isabel Island, Mexico, showing the *Velero III* and one of her launches in the left middle distance and a portion of the Mexican mainland beneath the cloud bank on the right horizon.

PLATE 67

- Fig. 144 Panorama of Isabel Island, Mexico, showing on the left the highest portion of the eastern half of the island, in the center the two stacks, crater lake, and reef-enclosed landing place, and on the right the semi-detached headland behind which may be seen the *Velero III* and the cloud-banked mainland of Sinaloa.
- Fig. 145 Reef on which much shore collecting was accomplished at Isabel Island, Mexico. Landings were made in the shallow cove to the right, which was reached through the narrow passage seen above the first headland.

PLATE 68

- Fig. 146 Rocky beach at Isabel Island, Mexico, showing nesting blue-footed boobies in the lower left-hand corner and a much-eroded sea stack in the right background.
- Fig. 147a Beach at Tenacatita Bay, Mexico, showing thatched huts occupied seasonally by palm nut harvesters in the middle distance. Chart 70, p. 404.
- Fig. 147b The southeast shore of Tenacatita Bay, Mexico, from Tenacatita Head on the left to Navidad Head, the cluster of islets on the right, has an average elevation of from 400 to 500 feet. A grove of coquita nut palms may be seen beyond the beach.

Mexico from Cape Corrientes to Guatemalan Boundary

Plates 65-76; Charts 70-73

Cape Corrientes, of itself, is not a particularly noticeable landmark, but it is situated at the tip of a prominent convexity in the coast line, south of which the trend changes definitely from south or slightly southeast to but little south of east. Off the Cape, in consequence, there are strong currents and tide rips such as are usually found in such situations. It is a bold headland, 506 feet high, and the wooded country back of it rises rapidly to mountain heights.

There is little variety in the coast line from Cape Corrientes to the Guatemalan boundary. It consists, in the main, of a series of sand beaches separated by rocky points. The sand beaches vary much in length, and the rocky points may be small and low, or in the nature of high bluffs, or even headlands of considerable width. There are very few indentations significant enough to be called bays, but along the whole coast there are anchorages, safe enough in the dry season, from December to May. Where there are bays, there are commonly outlying rocks and islands. As a background to the shore, the surface of the land rises rapidly and far to the high mountain heights, so that some of the highest mountains in Mexico can be seen in clear weather from a few miles offshore. The lower portion of the rise is often quite barren looking, but, higher up, the mountain sides may be heavily wooded.

South of Cape Corrientes the first location explored is Tenacatita Bay, some 80 miles from the Cape, still in the large convexity of the coast. It lies between Brothers Point to the west and Navidad Head to the southeast and is 5 miles across the entrance. Brothers Point is a high, bluff headland, connected to the mainland by a low, sandy isthmus. Lying offshore are some rocks and rocky islets. The north shore and the head of the bay are sandy. Along this shore a lagoon running parallel to the shore empties into the bay. The land at the head of the bay is wooded in part, and there are large nutpalm groves. The southeast shore is higher and more rugged, becoming more so as it extends outward to form Navidad Head, which separates Tenacatita Bay from Navidad Bay. Extending southward from Navidad Head is a chain of rocky islands. There is deep enough water for anchorage in most of the bay, but, when the northwest wind blows, the bay is much exposed.

The bay has been visited several times. Some interesting material has been obtained at the entrance to the lagoon and along the rocky shore, especially at Navidad Head. Dredging toward the head of the bay was

not very effective, but the rich fauna off Navidad Head more than makes up for any deficiency elsewhere. It is doubtful if any other location explored has so much to offer.

Leaving Tenacatita Bay to follow the coast with a trend somewhat south of eastward, there is nothing to record for over 200 miles, until Petatlan Bay is reached. The landward view is much like it has been, except that perhaps the high mountains come a little nearer the coast, and higher individual peaks come into view. The two Colima peaks, the western sentinels of a long volcanic chain, are situated in the Tenacatita Bay hinterland. In many cases the immediate foreground is low, and there are many lagoons similar to the one near shore in Tenacatita Bay, running parallel to the coast. Manzanillo, the port of entry for the State of Colima, is situated on the east shore of Manzanillo Bay, 30 miles from Tenacatita Bay.

Petatlan Bay, 7 miles across at the entrance, forms an indentation in the coast line $2\frac{1}{2}$ to 3 miles deep, between a somewhat inconspicuous, rocky bluff to the northwest and Punta Gorda, the tip of a bold headland, 640 feet high, Morro de Petatlan, to the southeast. This headland is connected with the mainland by a low, wooded isthmus. On the bay side of the isthmus the shore is shingle or rock, but on the southeast side there is a long, sandy beach. On the seaward side of the headland the cliffs are abrupt, perpendicular in places, but they leave a low, narrow ledge between them and the water's edge at low spring tide. The east and north shores form a sandy beach.

Lying 1 to $1\frac{1}{2}$ miles westward of Punta Gorda are the White Friars (Potoci), a group of 12 rocks, of which 4 are large enough to be dignified by the name of islands or islets. They serve as nesting places for a variety of marine birds and are covered by guano to such an extent that, since they stand out clearly from the shore, they can be recognized for a long distance, particularly in approach from the southward.

Lying a mile off the northwest entrance to the bay is the conspicuous Black Rock, 46 feet high, and steep on all sides. To the westward of the bluff at the northwest limit of the bay and of Black Rock is the small but safe and well-protected bay, Sihuatenajo Bay, in which the *Velero III* anchored December 11 and 12, 1931.

White Friars have provided ornithological material and photographs. The shore on the bay side of Morro de Petatlan is rather barren, but the small strip at the base of the cliffs on the seaward side is much more interesting. Dredging in the bay has given only fair results. Near the White

Friars it is much better, especially on the south side, i.e., between White Friars and Morro de Petatlan. Two hauls were made in deep water, 5 miles out from White Friars, in the mud, with not very encouraging results. The depths were 60 and 100-140 fathoms. From the deeper haul, a larval spiny lobster created some surprise.

East-southeastward from Morro de Petatlan, 115 miles, is Acapulco Harbor. The entrance lies between the Acapulco heads. In the entrance and farther in the bay there are several islands, islets, and individual rocks, but there are safe passages into what "is considered the finest (harbor) on the west coast of Mexico." From the main bay there are secondary bays, upon the shore of one of which, Santa Lucia Bay, is situated the city of Acapulco, the port of entry for the State of Guerrero. All around the harbor are high mountains that provide shelter. The *Velero III* anchored here, southbound, December 14-15, 1931, and northbound, February 12-13, 1932.

There is one dredging station 16 miles southeast of Acapulco Harbor, 2 miles offshore, in 11 fathoms, fine sand.

From Acapulco Harbor, with the trend of the coast in the same general direction, it is 115 miles to Chacahua Bay. From Acapulco eastward, the high hills in the foreground and the high mountains in the background gradually disappear, and for 50 or 60 miles they are little in evidence. They begin to show again before Chacahua Bay is reached, so that they take on much the same appearance as they do west of Acapulco. The entrance to Chacahua Bay, 6 miles across, lies between two high, rocky headlands, Punta Galera to the west and Morro Hermoso to the east, which, like so many of the headlands along the Mexican coast, are each connected with the mainland by a low isthmus. There are rocks and reefs off Punta Galera, but few of them off Morro Hermoso. At the head of the bay a sandbar separates the bay from Chacahua Lagoon. There are a shore station at the margin of the lagoon and one at the rocks at the entrance, where *Heliasters* are abundant. There are dredging stations in the shallow water in the bay in sand, and outside the bay in 45-50 fathoms, mud.

East of Chacahua Bay the coast line continues eastward and then swings to form a southward convexity before turning north of east again to Tangola Tangola Bay, 95 miles from Chacahua Bay.

Tangola Tangola Bay, the last of three shallow indentations of the coast, with sandy beaches and rocky points between, is preceded by Santa Cruz Bay and Guatulco Bay. It is only 6 miles across the mouth of the

three of them. At a short distance offshore the three beaches appear to be continuous. From 10 miles out to sea these bays are difficult to locate or distinguish. In Tangola Tangola Bay there is a small island, Tangola Tangola Island. The bottom is sandy out to a depth of 25 fathoms, after which the sand is replaced by mud. A shore station on the rocky point and 3 dredging stations are located here.

West of Tangola Tangola Bay, 23 miles, situated on a small bay, is Port Angeles, the port of entry for the State of Oaxaca.

Beginning between Port Angeles and Tangola Tangola Bay, there is a long sweep of coast, northeastward, eastward, and southeastward, to form the Gulf of Tehuantepec. The distance across the mouth of the gulf, from Port Angeles to Suchiate Bar, where Mexico adjoins Guatemala, is about 250 miles. From such a line across the entrance to the head of the gulf it is 65 miles. This head is 120 miles southward of the southern shore of the Gulf of Mexico. From Salina Cruz the shore is a continuous, sandy beach, often backed by lagoons. Although throughout the whole of the Gulf there are few dangerous rocks, shoals, or obstructions, and although the sea bottom is even, deepening very gradually offshore, the effect of the strong winds coming across the trans-Mexican gap, which forms the Isthmus of Tehuantepec, which are felt for great distances out to sea, and the disturbance that these set up in the ocean currents in this region make the reputation of the Gulf of Tehuantepec anything but savory. In the days of sailing vessels passage across the Gulf was often hazardous, and even now, in the days of large steamships, it may be an unpleasant experience.

Salina Cruz, 55 miles east of Tangola Tangola Bay, the terminus of the Tehuantepec Railroad, was a busy port at one time, but after the completion of the Panama Canal it deteriorated badly. Apparently it is now coming into its own again.

The only collecting station in the whole Gulf is a dredging station, 20 miles offshore, State of Chiapas, $15^{\circ} 41'$ North, $94^{\circ} 08'$ West, in 35 fathoms, mud, where a catch of shrimps was the chief feature of the haul.

Central American Coast

Guatemala

Plates 77-80; Chart 74

The coast of Guatemala extends from Suchiate Bar, southeasterly and then easterly for 140 miles. The sandy coast is regular, with no indentations of importance, although there are several roadsteads, the most important of which are Champerico and San José. At both of these there are ports of entry, connected by rail with the interior. Champerico is 30 miles from the Mexican border, and San José 40 miles from the boundary of El Salvador. The landward slope from the shore is rather gradual, but it extends to a continuous range of high mountains in the interior, some of which are actively volcanic. The two most notable of these volcanoes, directly north of San José, are Agua, 12,334 feet, and Fuego, 12,603 feet, connected by a high ridge. When the atmosphere is clear, in the morning or early forenoon, these are readily visible far out to sea. Later in the day they are likely to be obscured by heavy smoke.

No shore collecting has been done off the coast of Guatemala, but there are several dredging stations, all in sand, in the vicinity of San José, in 3-5 fathoms inshore to 56 fathoms 30 miles out.

El Salvador

The coast of El Salvador extends slightly south of east from the Guatemalan boundary, approximately 140 miles, to the Gulf of Fonseca. The coast and its background are similar to that of Guatemala. The mountains are closer to the sea, but the highest of them are far from being as high as those in Guatemala. There is one irregular bay, Jiquilisco Bay, 30 miles west of the Gulf of Fonseca, but it is largely filled up with low islands. There are two ports of entry, Acajutla, 20 miles from the western boundary, and La Libertad, 30 miles east of Acajutla. No collecting has been done along the coast of El Salvador.

The Gulf of Fonseca is a large inlet, 19 miles wide at the entrance and practically that width for 12 miles, after which it diverges to a width of more than 40 miles, giving off a number of secondary inlets, the farthest point from the entrance being 25 miles. The landward portion consists largely of mud flats, and there are numerous islands, large and small, in various parts of the gulf.

Three countries share the coast line of the Gulf—El Salvador, the western shore, for 16 miles; Honduras, the northern and most of the western shore, for 38 miles; and Nicaragua, the remainder, 17 miles to

Monypenny Point and then 12 miles to the open sea at Punta Chiquirin. El Salvador has a port of entry, its most important port, at La Unión; Honduras has one at Amapala; but Nicaragua has none.

There is no collecting station in or near the Gulf of Fonseca.

Nicaragua

Plate 76

Around the Gulf of Fonseca and along the Nicaraguan coast, which extends southeasterly 160 miles, to Salinas Bay, the immediate background is low, and the mountains farther back are not so high. There is a distinct chain of these extending from the Gulf of Fonseca to Lake Managua, close to the shore at first, but gradually receding to the eastward. The chain contains many active volcanoes, of which Mount Viejo, 5,670 feet, inland from Corinto, and Monotombo, 3,910 feet, on the shore of Lake Managua, are probably the most prominent, as seen from the sea in clear weather.

The coast line is still regular, and there is no conspicuous inlet anywhere. The nearest approach to one is Corinto Harbor, 40 miles from the Gulf of Fonseca, on which is situated the Port of Corinto, the only port of entrance of importance. The *Velero III* anchored here February 6-9, 1932. There is one dredging station, 11 miles northwest of the port, in 1-3 fathoms, in sand and dead leaves.

Costa Rica—Cocos Island

Plates 76-81; Charts 75-78

In crossing the boundary between Nicaragua and Costa Rica, beginning with Salinas Bay, the nature of the coast becomes different. Instead of the regular coast line, inlets and peninsulas, with or without pointed headlands, follow in succession, so that the point-to-point measurement from Salinas Bay to Punta Burica of roughly 300 miles gives but a slight idea of the amount of actual coast line. Enough variety is introduced to kindle real enthusiasm in a marine zoologist.

The coast line, in general, is bolder, rising abruptly to form cliffs or bluffs, or more gradually to rolling hills that are never of great height. One misses the high mountains in the distant background, as they are too far inland to be seen from the sea. Sandy beaches are relatively scarce. The open coast often shows evidence of aridity, with but little except cactus in sight, but the shores of the bays may be quite well wooded.

Salinas Bay is a secondary extension of the larger inlet, the Gulf of Papagayo, which extends from San Juan del Sur in Nicaragua to Cape

Elena in Costa Rica, 22 miles, and landward 12 or 13 miles to the head of Salinas Bay or Elena Bay. The Gulf is well named, for the land breeze—papagayo—is prevalent, at least at some seasons of the year, from Corinto, Nicaragua, well down the Costa Rican coast, often getting away beyond the zephyr stage in this region.

There are three secondary extensions of the Gulf of Papagayo—Salinas Bay, Elena Bay, and Playa Blanca Bay. The shore of Salinas Bay forms a regular curve from Arranca Barba Point at the northwest entrance to Point Sacate at the southwest entrance. These points are $2\frac{1}{2}$ miles apart, and the bay extends landward about 4 miles. The northern shore is high and bold, but the eastern and southern shores consist of sandy beaches separated by low bluffs. Salinas Island is situated not far from the center of the bay.

There are one shore station in the sandstone on the south shore of the bay and several dredging stations between Salinas Island and the mouth of the bay, in sand or mud, none deeper than 20 fathoms.

The peninsula between Salinas Bay and Elena Bay has a sea front of $2\frac{1}{4}$ miles, from Point Sacate to Descarte Point. Elena Bay is wide open to the westward. The north shore extends southeastward for about 5 miles; the head (east shore), $3\frac{1}{2}$ miles across, consists of two smaller secondary bays; and the south shore extends for 11 miles almost directly westward to Punta Blanca, with but one break to form Port Parker, $4\frac{1}{2}$ miles from the point.

Port Parker is an excellent landlocked harbor, but is not large, 2 miles long, 1 mile wide. The cliffs that guard the entrance on both sides do not extend to the head of the bay, for from the southern shore sand and mud flats extend outward for some distance. Collecting has been done on the rocky shore of a small island at the entrance of the port, and on the sand beach at the head coral masses have been collected; there are several dredging stations in 2 to 30 fathoms, in mud, sand, and shell.

Punta Blanca is a long point separating Elena Bay from Playa Blanca Bay. "This bold and striking headland projects to the westward, its rocky sides rising abruptly from the water to the sharp and jagged summit, which, at about a mile within the point, is 681 feet high."

Playa Blanca Bay is shaped much like Elena Bay, but is not nearly so large. The entrance between Punta Blanca and Cape Elena is 6 miles wide. The north shore to the head of the bay is 2 miles, and the south, or southeast shore, 6 miles. The head of the bay is a sandy beach; the remainder of the shore is rocky. There are one shore station in shale, one

for coral masses, and several dredging stations in 2 to 40 fathoms in a variety of bottom, mostly from the head of the bay along the north shore, out past Punta Blanca, but there is one near Cape Elena. The dredge hauls in the mud and dead shell were not very productive.

Cape Elena is a conspicuous, long, narrow, rocky ridge, like Punta Blanca, rising high, abruptly from the water's edge. South of Cape Elena, the Gulf of Culebra, larger than the Gulf of Papagayo, extends 32 miles to Cape Velas. Within the gulf and forming the head of it is an open bay, not named on the charts, 16 miles long and 7 miles wide. The north shore of the gulf is bold and hilly, but the remainder of the coast, in general, is relatively low. There are several small sandy beaches. On the north shore, between Cape Elena and the entrance to the inner bay, there are two small bays, wide open toward the south, Murcielago Bay, containing the Bat Islands and the Little Bat Islands, and Potrero Grande Bay, free of islands. Appearing as extensions of the southern portion of the inner bay, there are a number of small bays, the most important of which is Port Culebra; "the finest harbor in Central America is spacious, secure, and easy of access, with depths sufficient for the largest ships." The entrance to the southwest, 1 mile wide, lies between Mala Point, to the north, and Buena Point, to the south. Inside the entrance, it increases in width to 2 miles or more; the head is 4 miles from the entrance.

Off Point Mala are the North Viradores, two rocky islets, the outer of which has a conspicuous rocky column 60 feet high.

Although Buena Point is at the immediate entrance to Port Culebra, it might be considered that the southeast shore extends beyond this point to Cacique Point, 2 miles farther out, off which are the South Viradores, three small grass-covered islets that stand out similarly to the North Viradores to guard the entrance to the port.

Although the harbor is safe and secure, the papagayo that blows up during the day may make the surface choppy enough to materially disturb small boats. The coast here supplies a good example of the way in which the arid cactus-laden, sea-swept points lead inland to well-wooded surfaces or even good grazing land.

Shore collecting has been done along the slough on the south shore, on the rocks at Mala Point, Buena Point, and Cacique Point, dredging from the head of the bay, where mollusks and echinoderms are dominant, to out past the South Viradores, in depths of 20 fathoms or less. The bottom varies, there being mostly sand, mud, and shell at the head of the bay and sand, shell, and rock farther out, with a greater variety of species. Coral masses were obtained from near Point Mala.

Southwest of Cacique Point there is a small bay, $1\frac{1}{2}$ miles wide, Cocos Bay, at the head of which is a port of entry. There is one dredging station near the head of this bay, in 2 fathoms, sand and shell.

The southwest extremity of Cocos Bay is Miga Point, and beyond it is Gorda Bay, extending 4 miles to Gorda Point, the southwest extremity of the inner bay. Southwest of Gorda Point is another point (unnamed) $2\frac{1}{2}$ miles away, off which are the Brummel Islands, and the Catalina Islands, farther out. From this point to Cape Velas, 10 miles, there is a bight extending at the head to two smaller bays. This is the southern limit of the papagayos.

From Cape Velas, the coast, not quite regular, extends for 30 miles south-southeastward to Guionos Point, then east-southeastward, 21 miles, to Quinones Point, and from this point, much the same distance south-eastward to Cabo Blanca, at the western entrance to the Gulf of Nicoya.

Much of the coastal area around the southern half of the Gulf of Culebra and on to Cape Velas is lower than the coast of Costa Rica, farther north, but after Cape Velas it becomes hilly again. Most of the shore line is bolder and there are few sandy beaches. There are no inlets of importance between Cape Velas and Cabo Blanca.

Cabo Blanca serves as a striking landmark, for here the coast turns and turns again so abruptly that a well-marked peninsular headland is formed. The point rises rapidly, so that within one mile it has an elevation of 1,200 feet. This height is kept with little change to form a tableland extending inland for 6 miles, after which there is a receding slope to a lower plain. Isla Blanca lies one mile south of the point.

Gulfo de Nicoya (Gulf of Nicoya) is a large body of water, 34 miles wide at the entrance, between Cabo Blanca and Punta Judas, extending into the land, first northward and then northwestward, 52 miles. From Cabo Blanca the shore extends northeastward 23 miles to Negritos Island, largely as a series of small bays, often with sandy shores, separated by rocky points. From Negritos Island to the head there are numerous islands and much shoal water off the shore. That is true to some extent of the northeast shore as well, but it is not carried to the same extreme. Punta Arenas, a 4-mile, slender tongue of land extending westward, separates the inner part of the gulf from the outer. Near it is the port of entry, Puntarenas, near which the water is too shallow for any but quite small boats.

From Punta Arenas to Herradura Point there is a long bight, from which the shore passes southeasterly 10 miles to Punta Judas, a bold point

and headland, not so conspicuous as Cabo Blanca. Off this point the heavy breakers make it one of the principal danger points of the coast.

There are no dredging stations in the Gulf of Nicoya or its vicinity.

From Punta Judas the coast takes a long sweep, southeast and south, 73 miles to Llorena Point, the greatest depth of the bight being 21 miles. In general, the coast is bold from the water's edge or near it; but, even when it is low, it soon reaches an area of elevation to a chain of coastal mountains, higher than any others so near the coast for a long distance to the northwest. They are so near the shore that for some distance out at sea they hide the really high mountains farther inland. Mount Walker is 12,413 feet high. There are no very distinct irregularities in the shore of the bight.

Llorena Point is the western extremity of a large peninsula that separates the Gulf of Dulce, to the westward, from the open sea. The point itself is high and steep, and from it the coast extends 14 miles southeasterly to Sal Si Puedes Point, and then eastward for 18 miles to Matapalo Head at the entrance of the Gulf of Dulce. Three points are high and rocky, but most of the coast between them is low and sandy. Except for a ridge extending inland between the first two points, which remains low for some distance inland, the hilly country is not very far from the shore.

The Gulf of Dulce extends northward and then northwestward for 28 miles, with a width of $8\frac{1}{2}$ miles at the entrance between Matapalo Point and Banco Point, and within the entrance varying from 5 to 11 miles. The west coast is low, with hilly country near; the head is bolder, but the hills are farther from shore. These appear again in the northern portion of the east shore, but soon disappear again, so that the southern portion is low. There are depths of over 100 fathoms in the gulf, unusual for the Central American coast. There are several small, secondary bays and plenty of good anchorages. Collecting has been done on the shore among the large basaltic boulders near Matapalo Head by dipping under the cargo light and by dredging near by in 10 to 40 fathoms, sand and mud.

From Banco Point, or perhaps more correctly from Platanal Point, 3 miles to the southeast, there is another wide bight, this time a very shallow one, extending to Punta Burica, 24 miles from Platanal Point, with practically no sign of any smaller irregularities in the coast line.

Punta Burica is the terminus of a 15-mile, narrow peninsula, extending almost directly southward, only 2 miles wide a short distance from the point and 6 miles wide at the base. At this point Costa Rica meets

Panama. There is a small island, Isla Burica, lying about $\frac{1}{2}$ mile off the point and connected with it by a reef.

Before leaving Costa Rica, it might be well to consider one of its island possessions, Cocos Island, $5^{\circ} 32'$ North, 87° West, which lies 280 miles to the southwest of Burica Point and approximately twice that distance due west of Cape Corrientes, Colombia. Cocos Island is roughly rectangular, with the long axis northeast-southwest. Its greatest length is slightly over 4 miles and its greatest width over 2 miles, the circumference 13 miles. On the north coast there are two definite bays, Chatham and Wafer, but the remainder of the coast is regular. It is everywhere bold and quite precipitous. The whole island is covered with dense, tropical vegetation, as there is an abundance of moisture, with streams of water descending to the coast. One emptying into Wafer Bay is readily observed from the sea. The greatest height is reached in a peak, 2,788 feet high, near the west coast. There are several small islands near shore, the largest of which is Nuez Island, off Colnett Point, the northern tip of Cocos Island, at the western extremity of Chatham Bay.

Chatham Bay, which affords the best anchorage, is an indentation at the northeastern portion of the island, between Colnett Point and Pitt Head. Wafer Bay occupies the central portion of the northwest coast.

Three visits have been made to Cocos Island. Shore collecting has been done on the rocks, in the fresh-water stream; and by cargo-light dipping has been done in Chatham Bay. Collecting has been done on the rocks, in shingle, in fresh water, and in tide pools in Wafer Bay. Dredging has been done in Chatham Bay in shallow water, sand, and, farther out, off Nuez Island in coralline. There is only one dredging station in Wafer Bay.

Lying east of the peninsula that ends at Punta Burica, extending 30 miles to Isla Partida and landward 16 miles, is Bahia Charco Azul (David Bay). The western shore of the bay is high, but the northern shore is low and cut by several rivers. Isla Partida is the farthest seaward of an archipelago of deltas, large and small, 22 miles east and west and 15 miles north and south, at the mouths of the estuaries of several Panamanian rivers.

Eastward and southeastward of the archipelago is a sweep of coast line, over 40 miles to Punta Guarida, at the entrance to Bahia Honda. The coast is low like that adjacent to the archipelago, with estuaries and bays but with few deltas or other islands.

Panama and the Canal Zone

Plates 82-86; Charts 79-82

Southeast of the archipelago, 20 miles, is another small archipelago, but the islands here, Secas Islands, are rocky and irregular. Only two of them are large enough to be called islands, but besides these there are numerous islets and rocks. They are dotted over an area $5\frac{1}{2}$ miles north and south and 3 miles east and west. They are arranged to form a rough crescent, with the concavity toward the east. Three visits have been made to these islands and 20 collecting stations established, at which much good material has been obtained. The interior of at least one of the islands has been explored, and as one result a land iguana, 5 feet 3 inches long, was obtained.

On the shore rocks, reefs, and tide flats have been inspected and some good coral masses obtained. There have been dipping by electric light and dredging in several locations, nowhere in more than 25 fathoms, with a variety of bottom, sand, mud, coralline, nullipores, and shell.

Farther west-southwestward, 23 miles, are *Islas Ladrões*, three rocky, barren islets. There are one dredging station 4 miles southeast of *Islas Ladrões*, in 54 fathoms, green mud, and another 15 miles east of these islands and 10 miles southwest of *Secas Islands*, in 20 fathoms, gray mud.

Southeast of *Secas Islands*, 13 miles, there is still another archipelago, *Islas Contreras*, but these have not been visited.

The small, irregular *Isla Medidor* lies 2 miles to the northwestward of *Punta Guarida*, and a smaller island, *Isla Pacora*, to the south of this, with a narrow, rocky channel between. There are one dredging station north of *Medidor* and three between *Medidor* and *Pacora*.

Bahia Honda is an excellent harbor for vessels of any size, being deep, safe, capacious, and easy of access. The entrance between *Punta Guarida* and *Isla Centinela*, off *Punta Jabali*, is 1,750 yards wide, but inside the bay, the width reaches $3\frac{1}{2}$ miles. It is divided into two parts by *Isla Talon*, 1,350 yards long—the larger, *Bahia Chinche*, to the westward and the smaller, *Bahia Legamo*, to the eastward.

The shore is low and well wooded. Palm trees and bananas mark the position of single habitations, as well as that of the native village on *Isla Talon*.

Here there are shore stations in sand, rock, and rocky reefs, coral masses, dipping stations by electric light, dredging stations in depths of 5 to 35 fathoms on a variety of bottoms, but mostly on shell and nullipores.

The results obtained in the bay and near the entrance have not been so good as those from the channel between Medidor and Pacora islands.

Five miles off the entrance to Bahia Honda is Isla Canal de Afuera, and $6\frac{1}{2}$ miles southwest of this, the relatively large island, Isla Coiba, with a length of $21\frac{1}{2}$ miles and a width of 13 miles. South of the western part of the Isla Coiba and $3\frac{1}{2}$ miles from it is the triangular island, Isla Jicarón, $3\frac{3}{4}$ miles by 3 miles; and $\frac{1}{2}$ mile south of this again Isla Jicarita, 1 mile by $\frac{1}{2}$ mile. The northeast side of Jicarita is low and quite arid; the south shore is a perpendicular bluff and the west is much similar, although there are some small coves with a background of palm trees. There are one shore station on rock, with coral masses, on the northeastern part of the island, and dredging stations, one east of the northern part of the island, one to the west of the island, and one at the western entrance of the channel between Jicarita and Jicarón.

From Punta Jabalí southeastward there is a wide bight, extending 50 miles to Punta Mariato, with a large bay, Bahia Montijo, largely shut off from the open ocean by Isla Cebaco, extending northward 17 miles from the central portion. The first 15 miles of the shore of the bight is relatively rugged, but most of the remainder, especially that around Bahia Montijo, is quite low.

Punta Mariato is the southwestern point of a rectangular peninsula that lies between Bahia Montijo and the approach to the Gulf of Panama. The south shore extends 56 miles from Punta Mariato to Cape Mala, the southeastern point. The first portion is bold, but the remainder is low, although the deep water comes in quite close to the shore throughout the whole distance.

The west coast of the Gulf of Panama, extending from Cape Mala to the entrance to the Panama Canal, consists of two bights, a larger one, 25 miles across and 40 miles deep, and a much smaller one, 17 miles across and 8 miles deep, which forms the western part of Panama Bay. The whole coast is low, and the near-by water shallow. There are no significant, secondary irregularities.

South of the Balboa entrance to the Panama Canal, and 9 miles from it, are the two islands, Taboga and Taboguilla, 2 miles apart, with other islets and rocks in the neighborhood. Taboga is $2\frac{1}{4}$ miles long and $1\frac{1}{4}$ miles wide, almost divided into two parts by a cove on each side. Taboguilla is 1 mile long and $\frac{2}{3}$ mile wide. Both islands are wooded. Shore collecting in tide pools, on rocks, and on coral masses on Taboga and

dredging in shallow water, 5 fathoms as a maximum, have been the only activities here.

Balboa, situated at the head of the narrowed approach to the Panama Canal, is the Pacific port for the Canal Zone, a strip of land, 10 miles wide, extending across the isthmus of Panama to Cristobal on the Caribbean Sea. At Balboa there is a wide tide range, said to be over 20 feet at some of the spring tides. Some collecting has been done from the piles of the wharf at low tide.

Visits have been made to the laboratory on Barro Colorado Island in Gatun Lake, but the collecting here has been incidental. Some bats have been obtained from a cave near the Madden Dam.

Balboa, Canal Zone

Plate 84; Chart 82

Ashore there is no separation between Balboa and Panama City, but along the shore there is a point of land between the two, and Panama faces on Panama Harbor to the east of the city. It is something to see a real city, after leaving the last one, San Diego, so far behind. The fish market provided the only specimens obtained here.

Separating the present Panama Harbor from the harbor of the Old Town of Panama, destroyed by Morgan, is another small point of land. There are collecting stations on the rocks adjacent to the harbor of the Old Town.

From Old Panama the coast line forms a 75-mile crescent to Punta Brava, at the entrance to Bahia San Miguel. The coast is low, and, although there are several small bays and estuaries, the water is too shallow for them to be of much use in navigation. The water deepens gradually even some distance out from shore. The vegetation is now becoming more extensive, as this is the approach to the belt of tropical rain forests.

Lying off the southern half of this crescent, 10 miles as a minimum, is the Archipelago De Las Perlas, extending 30 miles north and south and 20 miles east and west. Isla del Rey, 15 miles long and $7\frac{1}{2}$ miles wide, is the largest of the group. There is no deep water between them and the mainland.

Bahia San Miguel, $14\frac{1}{2}$ miles wide at the entrance, between Punta Brava and Punta Garachiné, is very irregular, with bays and estuaries straggling off from it. It extends about 20 miles to the eastward. From Punta Garachiné the coast continues south-southeastward to Punta Piñas, 36 miles, with but one significant point, Punta Caracoles, along the way. The coast here is bolder, and the offshore water deepens rapidly.

Punta Piñas is at the tip of a slender, southerly projecting peninsula that serves as a perfect protection for Bahia Piñas, a small bay, $1\frac{1}{2}$ miles across at the entrance, extending northward for $2\frac{1}{3}$ miles, to form an excellent, safe anchorage. Here there are shore stations on rocks and in coral masses and dredging stations in 3 to 35 fathoms, in sand, mud, rock, shell, and coralline.

After Bahia Piñas the coast line continues the same general trend, 25 miles, to the Panama-Colombia boundary, and another 28 miles to Cape Marzo, at the entrance to Octavia Bay. Before reaching the cape, however, there is a definite indentation facing the northwest, Humboldt Bay.

Colombia

Plates 87, 88; Charts 83-87

Cape Marzo is bold and rocky, with a reef and detached rocks extending 3 miles south of it. It forms the western extremity of Octavia Bay, the coast of which extends northward, eastward, and southeastward to Point Cruces, 15 miles from Cape Marzo. The 2-mile northward extension of the bay is well sheltered. Collecting on the shingle and in the coral masses of the extending peninsula and dredging in 30 to 75 fathoms were the only activities here. In the shallower hauls there were sand and gravel, but in the deep ones only gravel and mud.

Point Cruces is much similar to Cape Marzo, at the tip of a southerly extending peninsula, with rocky islets offshore. It forms the western boundary of the Gulf of Cupica, extending 22 miles to Solano Point, but receding behind these points to form Cupica Bay to the north and Solano Bay to the south.

Cupica Bay is $5\frac{1}{2}$ miles wide and extends northward $3\frac{1}{2}$ miles. The peninsula to the west of it serves as an excellent shelter, and the anchorage is a safe one. There are one shore station here, on the inside of the rocky point, and one electric light station.

From Solano Point the coast line extends southward for 7 miles, to pass into another bight, extending 36 miles to Alusea Point. Fourteen miles from the north end of this bight there is a small fiordlike inlet, Port Utria, receding northward 3 miles, almost parallel to the coast. At the entrance it is but $\frac{1}{4}$ mile wide, but farther in it may be twice that. It is separated to the westward from the open sea by a high, narrow peninsula, with two islets and some isolated rocks off its extremity. It forms a safe, well-protected anchorage. The shores of the peninsula and

the islets are rocky, but the eastern shore of the port is mainly a sandy beach, extending outward to form a sandspit. Back of the shore the elevation increases rapidly; and, as this is well within the tropical rain-forest region, the hillsides are heavily wooded and the undergrowth is dense. Coconut palms, bananas, and papayas are grown in inhabited areas.

Port Utria has provided the stage for much endeavor. Three visits have been made to it, and 28 stations have been established in the vicinity. The shore stations are on the rocky shores of both the peninsula and the islands, and here too there are plenty of coral masses. In dredging in 10-50 fathoms the hauls made at and outside the entrance, and in the deeper water off the islands, were in mud; but nearer shore, outside the islands, and the channels between the islands, there are sand, shell, and rock, and here the fauna in evidence is much richer. Sea urchins and cake urchins are plentiful. Black and green sea snakes are very abundant.

The coast line from Alusea Point, 8 miles, to Cape Corrientes serves as the seaward face of a conspicuous, densely wooded promontory, with deep water coming close to shore. There is a 3-mile southern face to the promontory, east of which the coast turns north for a short distance to form the western shore of semicircular Cabita Bay, $3\frac{1}{2}$ miles wide and $1\frac{1}{4}$ miles deep. The high rocky coast ends with the peninsula, and the east shore is the beginning of a long stretch of low coast, with sandy beaches or mud flats and numerous estuaries. In the vicinity of Cabita Bay the jungle must reach nearly the maximum of impenetrability.

The rocky shore of the peninsula and the sandy beach at the head of the bay have provided some specimens, but any attempts at dredging have been largely abortive. The bottom consists of such finely divided mud or silt that it has not enough consistency to trip the bottom-sampler. Possibly no other place explored offered such poor marine collecting.

From Cabita Bay the coast passes directly southward and then slightly westward to Chirambira Point, on one of the islands in the delta of the San Juan River, 72 miles from Cape Corrientes. The main mouth of the river is 10 or 12 miles farther south.

Directly west of the mouth of this river, 250 miles, is the 1-mile long, barren, high, perpendicular rock, Malpelo Island. There are three solitary rocks exposed north of the island, North Rocks, and five south of the island, South Rocks. The island is a pinnacle, 846 feet high, above water, that comes up from the bottom of what otherwise is a sea, mostly more than 1,000 fathoms in depth. A landing has been made on this island to do some shore collecting, but no attempt was made at dredging.

South of the mouth of the San Juan River, for a long way, the type of the coast line changes but little. It is 20 miles southeastward to Buena-ventura Bay, 80 miles southwest from this, 35 miles westward, and 32 miles south-southwest to the entrance of Ensenada Tumaco, which is 23 miles wide at the entrance. It is 18 miles southwest of this, and then 14 miles southeast to the boundary between Colombia and Ecuador.

Ecuador

Plates 89-92; Charts 89, 90

Lying 16 miles off the islands in the delta of the Sangnianga River, in the western trend of this part of the coast, is Gorgona island, 5 miles long north-northeast and south-southwest, and $1\frac{1}{2}$ miles wide, with three noticeable peaks, the highest 1,296 feet. In its ruggedness, in its lush vegetation, and in its abundant precipitation, it bears some resemblance to Cocos Island.

Just a quarter of a mile south of Gorgona is the smaller island, Gorgonilla, about a mile in length, with a precipitous shore except for a palm-laden beach near its northwest point. La Roca, a saillike or shiplike rock, $1\frac{1}{2}$ miles south of Gorgonilla, is a conspicuous landmark that can be seen from the south for a long distance.

Three calls have been made at Gorgona Island, and 24 collecting stations established. The shore collecting has been largely confined to the north end and the east side, as far south as Watering Bay, some of it in the fresh-water stream there, mostly though on the rocks, and in the crevices and caves that abound around the northeast point. Coral masses are relatively abundant and easily obtained. For dredging, the east side of the island is not very good. The water deepens rapidly and the bottom is mostly mud, but not the silt variety near the mainland. Some mud brought up from 150 fathoms, northeast of the island, surely took the palm for real stickiness. North of the island, in rock and gravel, it is much better. Along the west side the water remains shallow much farther out, and in 30 fathoms or less the bottom is mostly shell. Sometimes the masses of shell are all dead and then the hauls are not so valuable. Farther south, toward Gorgonilla, the bottom is rocky, rough with corals, some of which may readily be seen in the clear, shallow water. In the channel between Gorgona and Gorgonilla the mud again appears.

From the Colombia-Ecuador boundary the coast extends southward, 80 miles, to Galera Point. Here the nature of the coast line begins to

show a change, but it is a very gradual one. An occasional cliff or bluff appears to break the monotony of the low, level shore, but there are still many estuaries, deltas, and mud flats.

Galera Point is the northwest point of a high, rocky promontory, extending southward 11 miles to Cape San Francisco. It much resembles the promontory at Cape Corrientes, but the face is convex rather than concave. It is the most northerly of the westerly projecting points in Ecuador. Behind the cape there is a bay, San Francisco Bay, which is much similar to Cabita Bay. There is a northern projection—a narrower, shallower portion, running farther inland. A small river, or stream, comes down to this portion, but at low tide is pretty well shut off from it by a sandbar. Near the mouth are clusters of graceful trees, outliers of the denser forests farther back. East of the mouth of the river is an extensive sand beach, behind which the native village of San Francisco is situated. Seining has been done in the mouth of the stream, and shore collecting on the rocky shore of the projecting peninsula. As in other places in this region, dredging in the mud is not effective. The only place to get worthwhile material is in shallow water over the reef, where dredging is anything but a smooth procedure.

From Cape San Francisco there is a wide bight, 65 miles, to Cape Pasado and then a less extensive one, 50 miles, to Cape San Lorenzo. The southern shore of the latter bight runs directly westward; and in it, 15 miles from Cape San Lorenzo, is the small indentation, Manta Bay, on which is located the town of Manta, the port for Montechristi, where the finest Panama hats are made. Coral masses have been collected in Manta Bay, and the rocky shores and the reefs have provided some material, but no dredging has been done in the vicinity.

La Plata Island lies 16 miles southwest of Cape San Lorenzo. It is $3\frac{1}{2}$ miles long, northwest to southeast, and $1\frac{1}{4}$ miles wide. It reaches a height of 615 feet, and, in general, the shores are precipitous, although there is a somewhat more gentle slope in a ravine that passes down to a beach on the east shore. It is quite unlike Gorgona Island, since much of it is arid, although there is enough vegetation to support some cattle and numerous white goats. Shore collecting on the rocks and dredging in 10-15 fathoms near shore, and in 45-55 fathoms farther out, in mud, indicate the activities here. The shallow-water dredging is quite profitable, but the deeper dredging is too reminiscent of the coastal areas immediately to the northward to be satisfactory.

Directly south of Cape San Lorenzo, 33 miles, with a bight in the coast intervening, is a point off which Salango Island lies. There is a bar between the island and the mainland, but there is good anchorage north-east of the island. The island is 2 miles in circumference, high and covered with luxuriant vegetation. There are four dredging stations in sand near the anchorage, but no shore stations.

Thirty-eight miles south-southwest of Salango Island is Punta Santa Elena. There is a deep bight between, the southern portion of which forms Santa Elena Bay. Its eastern limit may be considered to be Centinella Point, 11 miles from Punta Santa Elena, and its depth is 3 miles. It is all shallow, with seldom more than 10 fathoms of water.

Punta Santa Elena is the tip of an abrupt, bare hill, 424 feet high, abrupt toward the land as well as toward the sea, for the remainder of the shore is low. The village of Salinas is situated on the shore 2 miles east of the point, and La Libertad, the port of Santa Elena, 1 mile inland, is 4 miles farther east than Salinas.

The shore has been explored off La Libertad, off Salinas, and along the open coast south of Punta Santa Elena. It is a suitable area for diving and dipping by electric light. Dredging in the open part of the bay, in sand, provides little; off Salinas it is somewhat better, but the real thrill comes in dredging in rough, rocky bottom at the entrance north of Punta Santa Elena, where almost every class of marine organism may be represented in a single haul. Gorgonids, echinoderms, and mollusks are particularly abundant. Mantas appeared to be more abundant off the point than anywhere else in the eastern tropical Pacific.

Punta Santa Elena is the northwestern extremity extending southwestward, between Santa Elena Bay and the Gulf of Guayaquil. The southwestern shore between Punta Santa Elena and Cape Morrow, 58 miles, faces on the outer part of the gulf.

The Gulf of Guayaquil is very large as gulfs and bays along the Pacific coast of South America go. The entrance from Punta Santa Elena, Ecuador, to Cape Blanco, Peru, is nearly 90 miles across, and from this entrance line to the mouth of the Guayas River it is over 100 miles. At the entrance to the inner part of the gulf, from Morro Point to Payana Point, it is still 36 miles wide. In the gulf there are several islands, the largest of which is Puná Island, 29 miles long and 8 to 13 miles wide, which lies to the southeastward of the peninsula already mentioned. There is one shore station just north of the eastern point of the island,

near the Village of Puná, where pilots are taken aboard by ships going up the river.

There are some small islands lying off Salinas Point, the southwest tip of Puná Island, the most conspicuous of which is Santa Clara Island, 12 miles out, near the center of the channel. It is surrounded by reefs and breakers. The lighthouse on the summit of the island, 256 feet high, and the light itself at night are visible for 22 miles out to sea.

On more than one occasion the *Velero III* has gone across the gulf and up the River Guaymas 40 miles to Guayaquil, but these trips were side issues as far as marine collecting is concerned; so the route need not be considered here.

PLATE 69

- Fig. 148 The White Friars, Mexico, a series of guano-covered rocks located near Acapulco and the site of a tremendous bird rookery. (Photographed by Wm. R. Taylor.)
- Fig. 149 Morro de Petatalan, a conspicuous headland along the Guerrero Coast of Mexico and principal landmark in locating the White Friars, a series of bird rocks from which this picture was taken. The birds are Brewster's boobies. Chart 71, p. 405.

PLATE 70

- Fig. 150 Fresh-water lagoon at Sihuatenejo, Mexico, in which several species of fish were netted by the expedition of 1931. Chart 71, p. 405, Station 3.

PLATE 71

- Fig. 151 View of Acapulco Harbor, Mexico, showing *Velero III* in the center and *U.S.S. Wright* at anchor to the left. Chart 15, p. 373.
- Fig. 152 Narrow entrance to the landlocked harbor of Acapulco, Mexico.

PLATE 72

- Fig. 153 The harbor at Acapulco, Mexico, viewed from a promontory on the north side of the bay. The old fortress may be seen at the end of the peninsula in the middle distance. The city has built up considerably since the picture was taken in 1932. Chart 15, p. 373.
- Fig. 154 Salina Cruz, located on the Gulf of Tehuantepec opposite the narrowest point of the Mexican Isthmus, and Pacific terminus of the shortest railroad across Mexico. Chart 15, p. 373.

PLATE 73

- Fig. 155 Tangola Tangola Bay, Mexico, showing the sand beach and rock shingle on which marine collecting was accomplished. The bay is located at the northern limit of the Gulf of Tehuantepec. (Photograph by Wm. R. Taylor.) Chart 73, p. 405.
- Fig. 156a Chacahua Bay, Mexico, looking across the estuary of the lagoon toward the rocky promontory which provides such shelter as the bay affords. (Photograph by Wm. R. Taylor.)
- Fig. 156b Chacahua Bay, Mexico, seen from the southeast. The conspicuous head at the left is Pt. Galero, elevation 190 feet. The lagoon entrance lies immediately to its right. Chart 72, p. 405.

PLATE 74

- Fig. 157 These spectacular sea stacks occur off the northwest end of Clarion Island and are the remnants of a former continuation of the bluff to the right in a westerly direction. The largest is Monument Rock. Chart 47, p. 395.
- Fig. 158 Braithwaite Bay, Socorro Island, as seen from the deck of *Velero III*. Mt. Everman, elevation 3,707 feet, is seen in the right background. Chart 46, p. 395.

PLATE 75

- Fig. 159 The coral sand beach at Sulphur Bay, Clarion Island, Mexico, where Hancock Expedition members landed on the rocky spit shown at the left of the picture. Plant growth consists principally of cactus, although a few low trees offer nesting sites to birds. Chart 47, p. 395.
- Fig. 160 Clipperton Island, only coral atoll in the eastern tropical Pacific Ocean. A 65-foot rock resembling a ship rises from the shallow lagoon. A few coconut trees are the only life visible. Chart 14, p. 372.

PLATE 76

- Fig. 161 View of the volcano Viejo or Chinandega, elevation over 5,000 feet, located 17 miles from the city of Corinto, Nicaragua. The fringe of mangroves is characteristic of the Central American shore line of Guatemala, Nicaragua, and San Salvador.
- Fig. 162 Port Parker, Costa Rica, presents a barren aspect in the dry season. A further touch of desolation is added by the black patches which represent burned areas. Numerous brush fires were raging at the time of the visit of the Hancock Expedition of 1939.
- Fig. 163 Port Parker, Costa Rica, located well within the zone of *Papagayos*, or windstorms. *Velero III* scientists worked in the lee of the small island, which is one of a series of stacks joined to the north shore of the bay.

PLATE 77

- Fig. 164 The beach at Gulf of Dulce, Costa Rica, showing lava reefs which make surf landing perilous. The dense jungle contains a few trees of notable height. Chart 77, p. 407.
- Fig. 165 Expedition members shown accoutered for field work in photography, mammalogy, herpetology, and botany, and marine zoologists already at work on the volcanic rock shingle which juts into the Gulf of Dulce, Costa Rica, at Matapalo Head.

PLATE 78

- Fig. 166 Lava rocks extending into the surf at Matapalo Head, Gulf of Dulce, Costa Rica. (Photograph by Wm. R. Taylor.)
- Fig. 167 Precipitous shore of Cocos Island, Costa Rica. The island affords but two landing places, Chatham Bay and Wafer Bay. Except for the water courses, which are the natural highways throughout the island, the interior is difficult of access. Chart 78, p. 408.

PLATE 79

- Fig. 168 Fresh-water stream at Wafer Bay, Cocos Island, Costa Rica. It was here that seine hauls were made for fishes occurring in the brackish water resulting from the mixture of salt and fresh water with the incoming tide. Shacks of treasure-seekers are located to the right of the picture. (Photograph by W. L. Schmitt.)
- Fig. 169 The surf at Chatham Bay, Cocos Island, Costa Rica, showing Nuez Island in the right background.

PLATE 80

- Fig. 170 Nuez Island, a satellite of larger Cocos Island, Costa Rica. Both are covered with dense tropical vegetation of a brilliant green color. The picture is taken from the deck of *Velero III* anchored in Chatham Bay.
- Fig. 171 Estuary at Puerto Culebra, Costa Rica, showing punt used to negotiate the narrow channels, often overgrown with mangrove thickets. Chart 76, p. 407.

PLATE 81

- Fig. 172 Puerto Culebra, Costa Rica, seen from behind a dense growth of columnar cacti.
- Fig. 173 Skiff among coral heads exposed at an especially low tide on one of the islands of the Secas group, Panama, a favorite collecting ground for *Velero III* parties. Chart 79, p. 408.

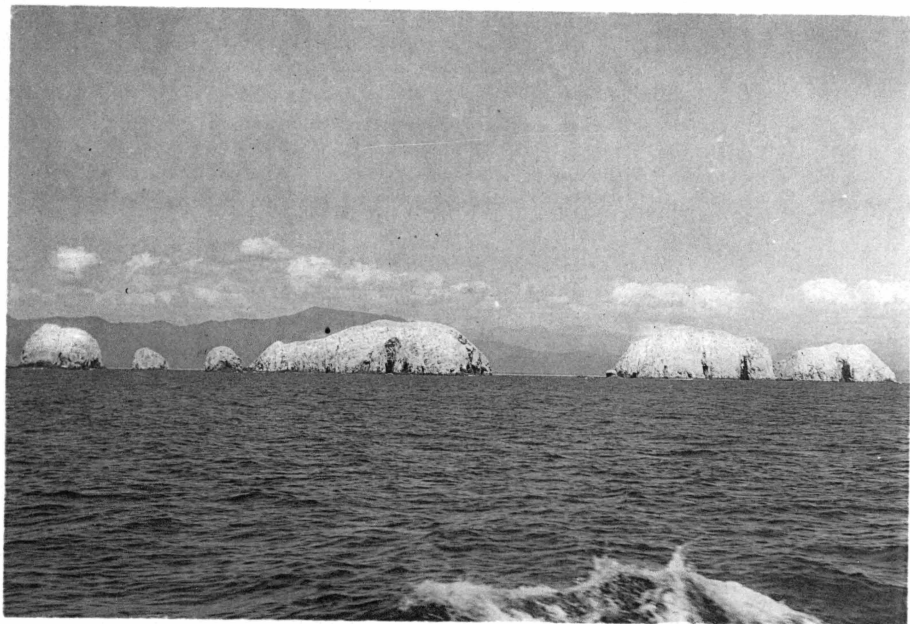


Fig. 148 The White Friars, Mexico

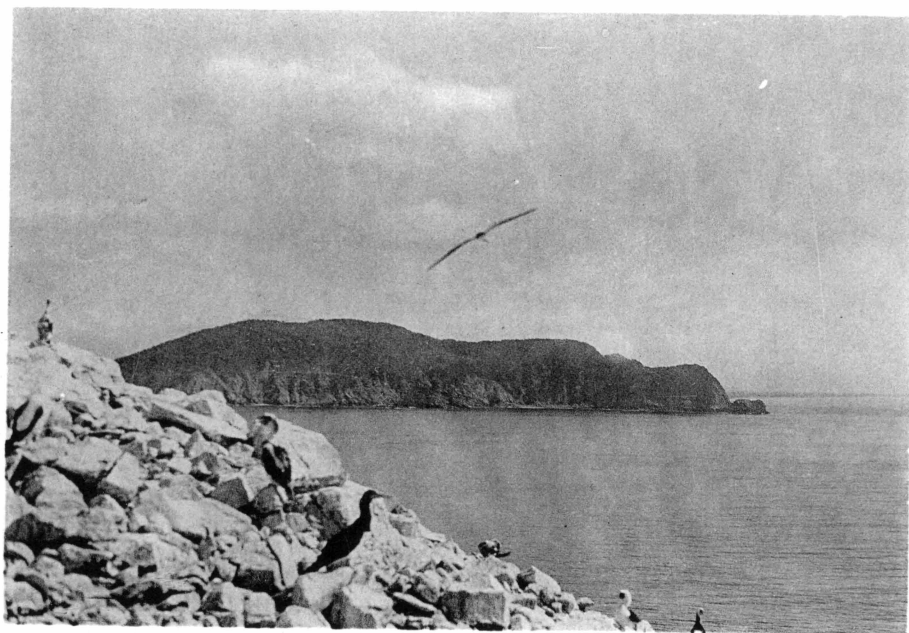


Fig. 149 Morro de Petatlan, Mexico

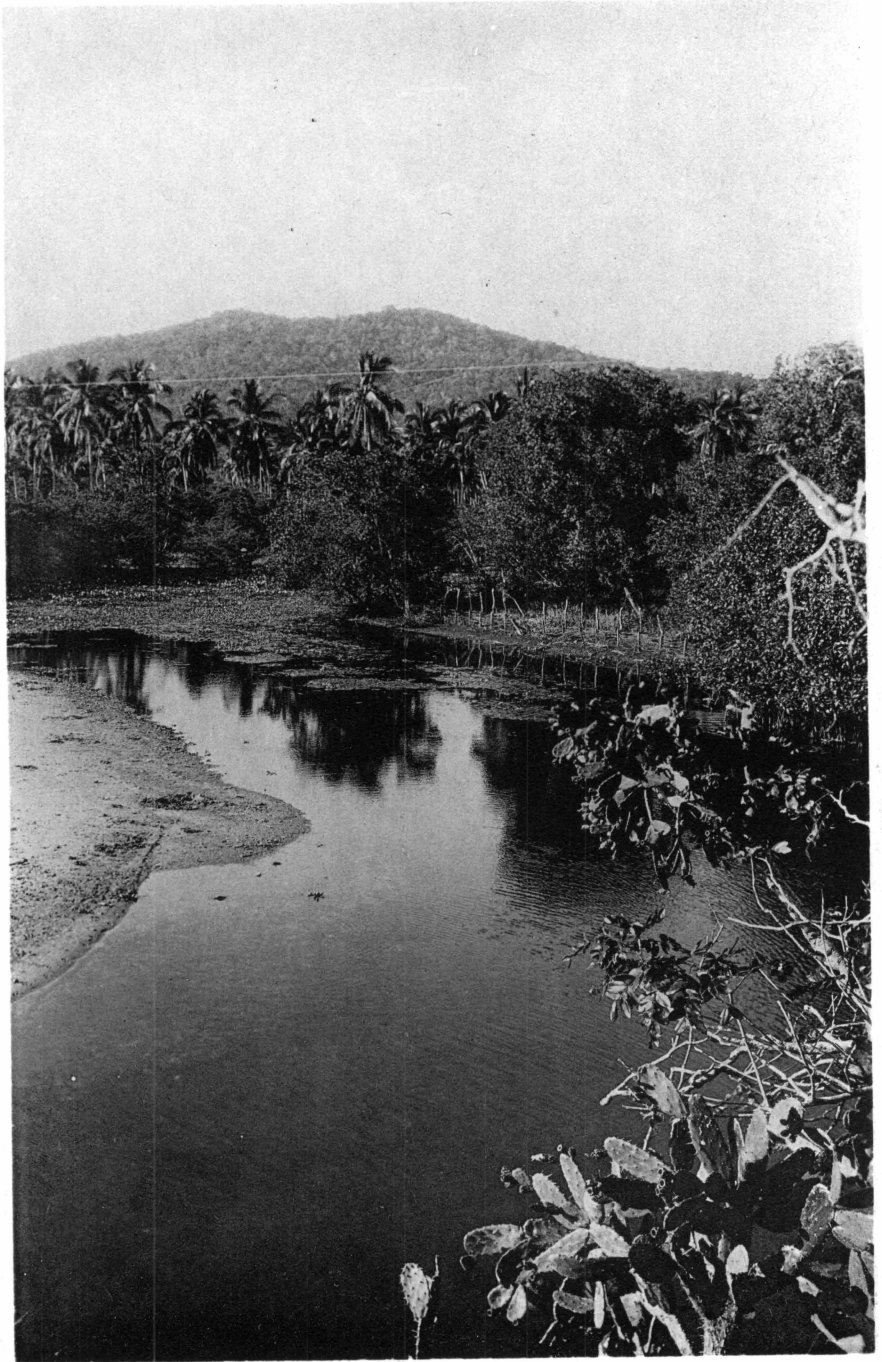


Fig. 150 Lagoon at Siuatenejo, Mexico



Fig. 151 Acapulco, Mexico, harbor



Fig. 152 Acapulco, Mexico, harbor

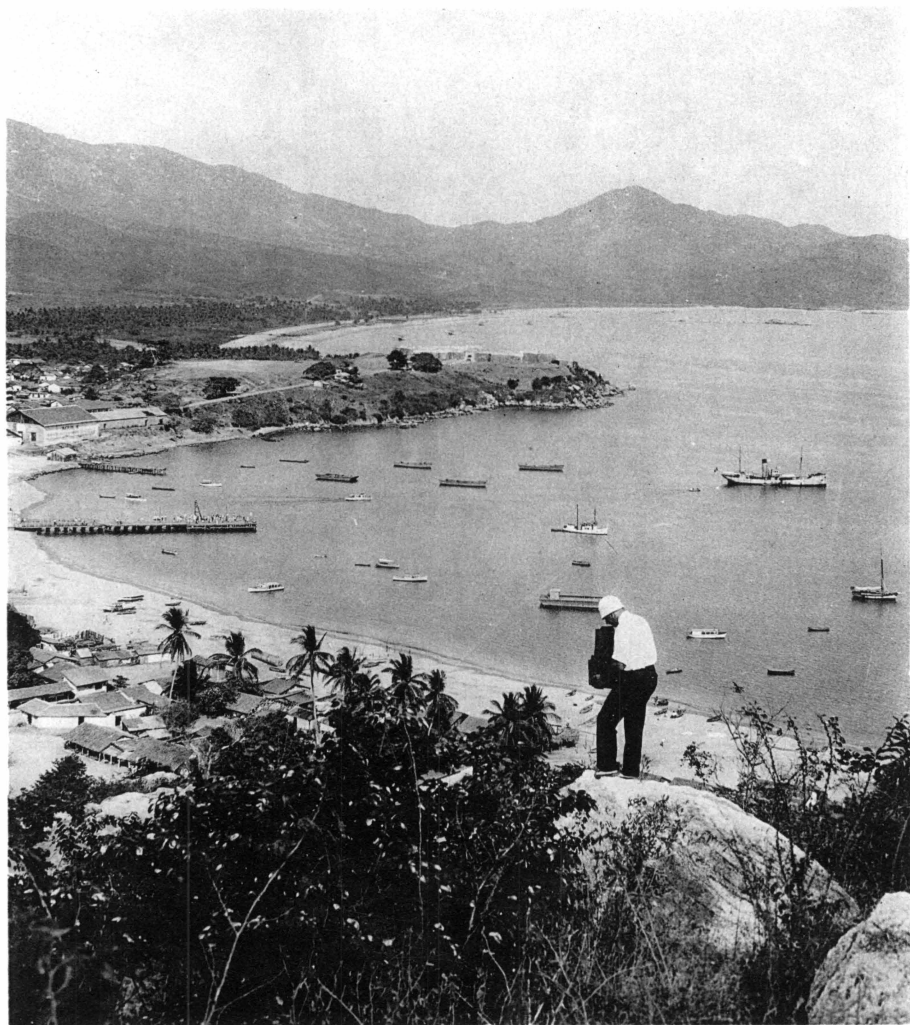


Fig. 153 Acapulco, Mexico, harbor



Fig. 154 Salina Cruz, Mexico

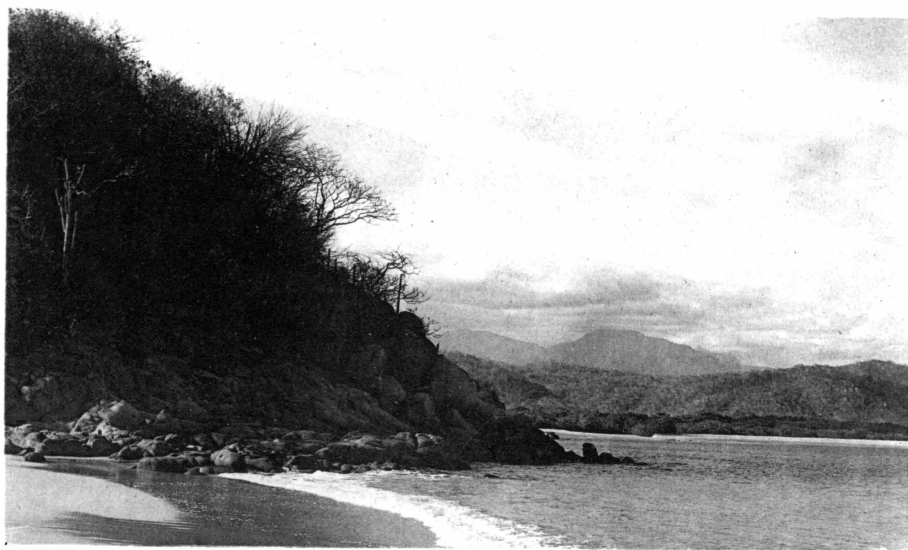


Fig. 155 Tangola Tangola, Mexico

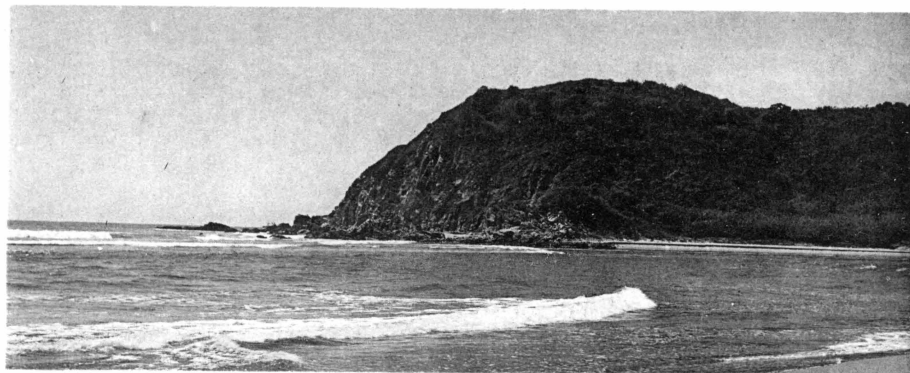


Fig. 156a Chacahua, Mexico, lagoon entrance



Fig. 156b Chacahua Bay

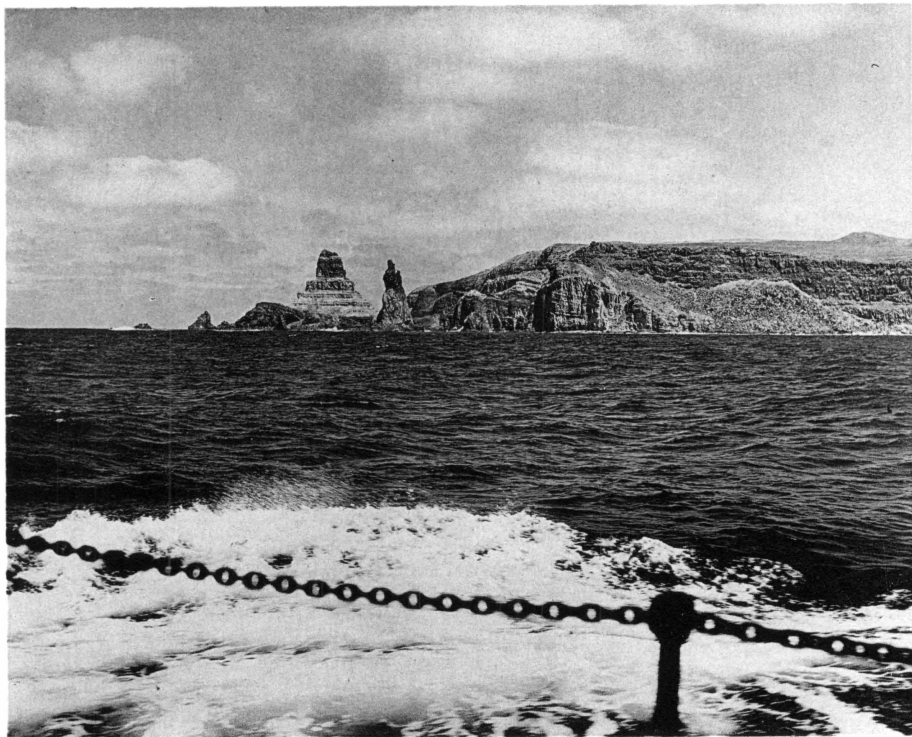


Fig. 157 Clarion Island, Mexico

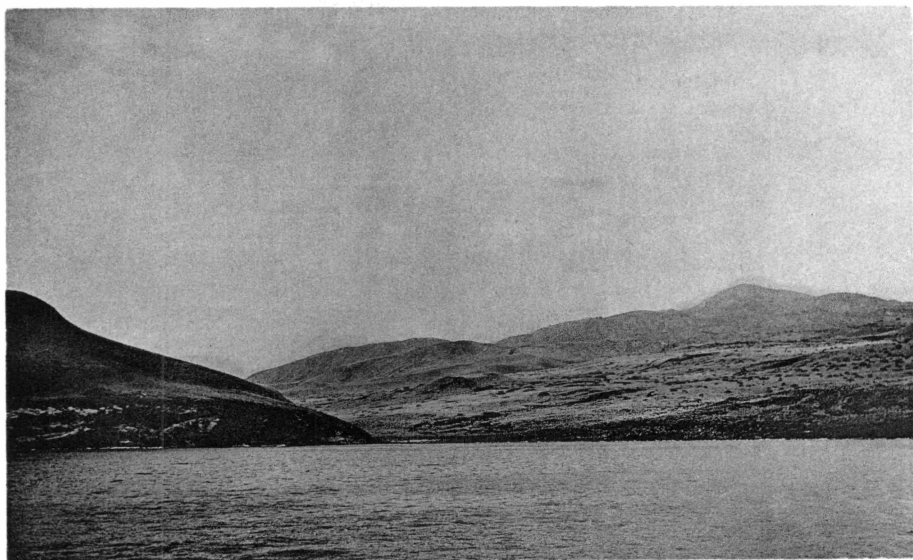


Fig. 158 Braithwaite Bay, Socorro Island, Mexico



Fig. 159 Clarion Island, Sulphur Bay

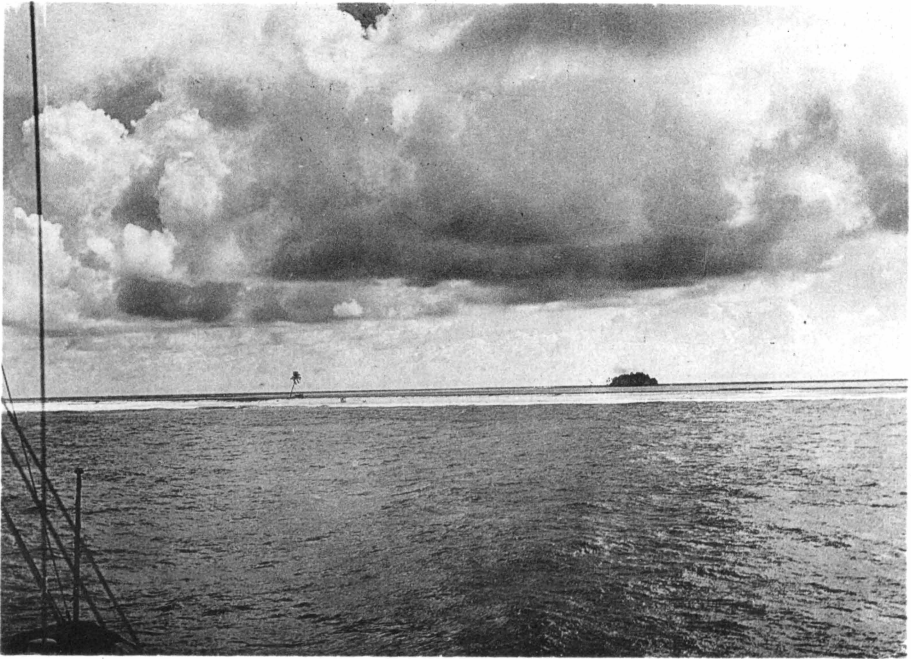


Fig. 160 Clipperton Island



Fig. 161 Volcano Viejo, Nicaragua



Fig. 162 Port Parker, Costa Rica



Fig. 163 Port Parker, Costa Rica



Fig. 164 Gulf of Dulce, Costa Rica



Fig. 165 Gulf of Dulce, Costa Rica

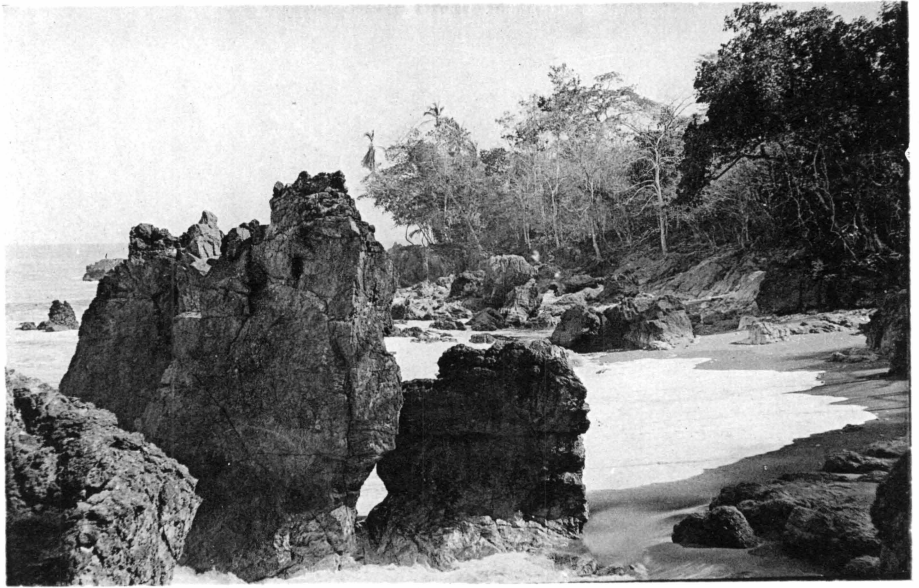


Fig. 166 Gulf of Dulce, Costa Rica

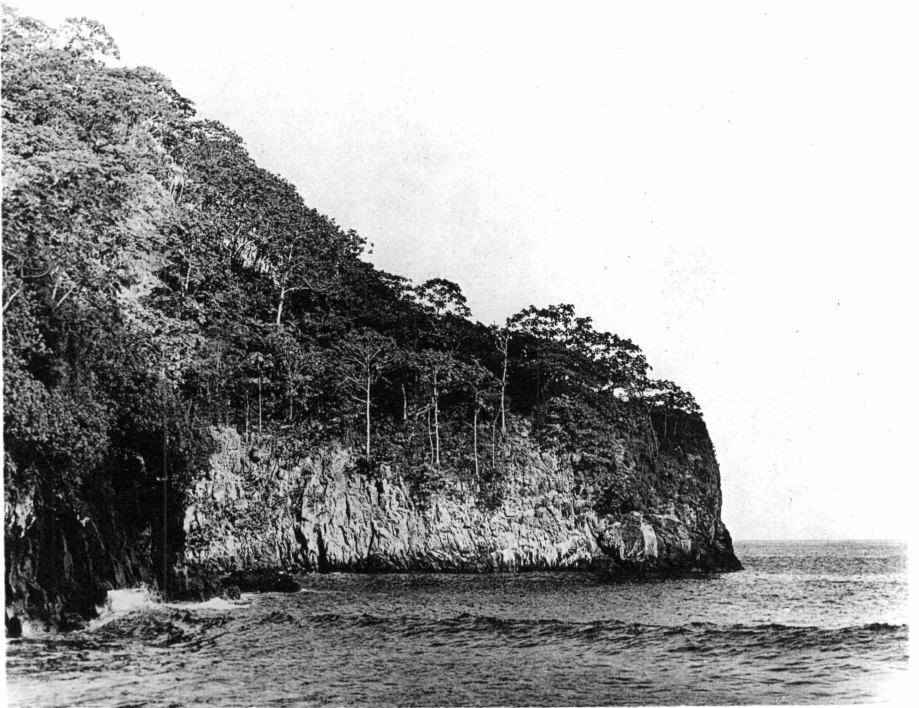


Fig. 167 Cocos Island, Costa Rica



Fig. 168 Wafer Bay, Cocos Island, Costa Rica

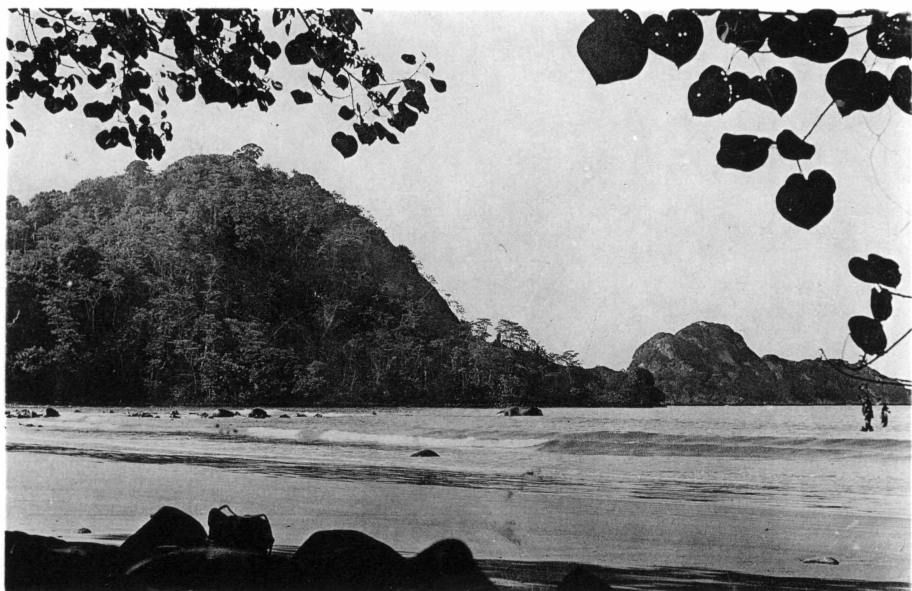


Fig. 169 Chatham Bay, Cocos Island, Costa Rica



Fig. 170 Nuez Island and Cocos Island, Costa Rica



Fig. 171 Puerto Culebra, Costa Rica



Fig. 172 Puerto Culebra, Costa Rica



Fig. 173 Secas Islands, Panama, coral heads

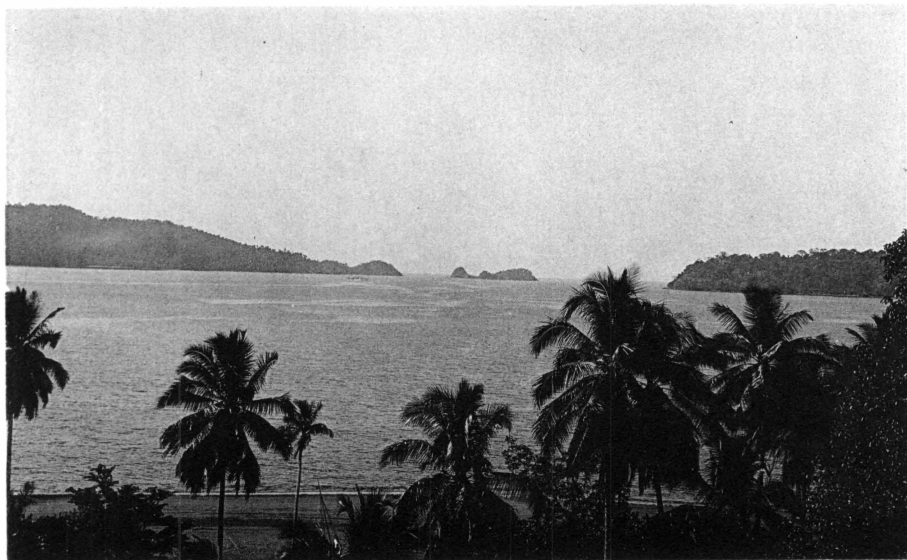


Fig. 174 Bahia Honda, Panama, seen from north shore



Fig. 175 Bahia Honda, Panama, north shore



Fig. 176a Panama, Jicarita Island

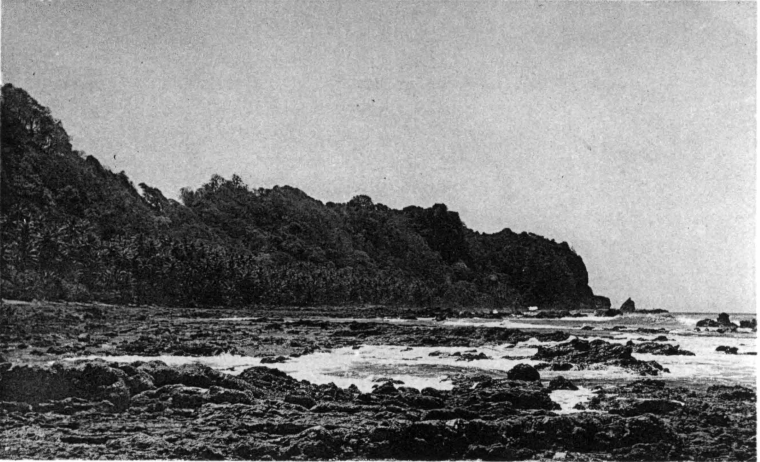


Fig. 176b Panama, Jicarita Island

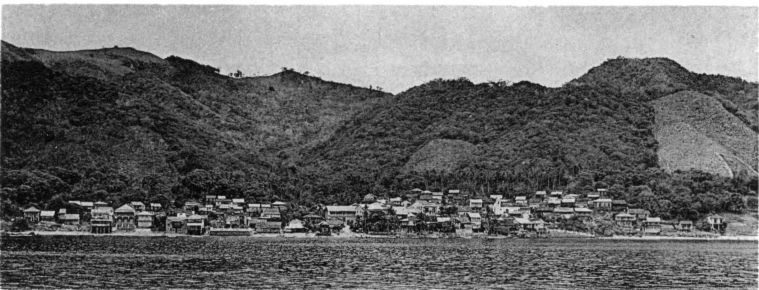


Fig. 177 Panama, Taboga



Fig. 178 Panama City, Panama

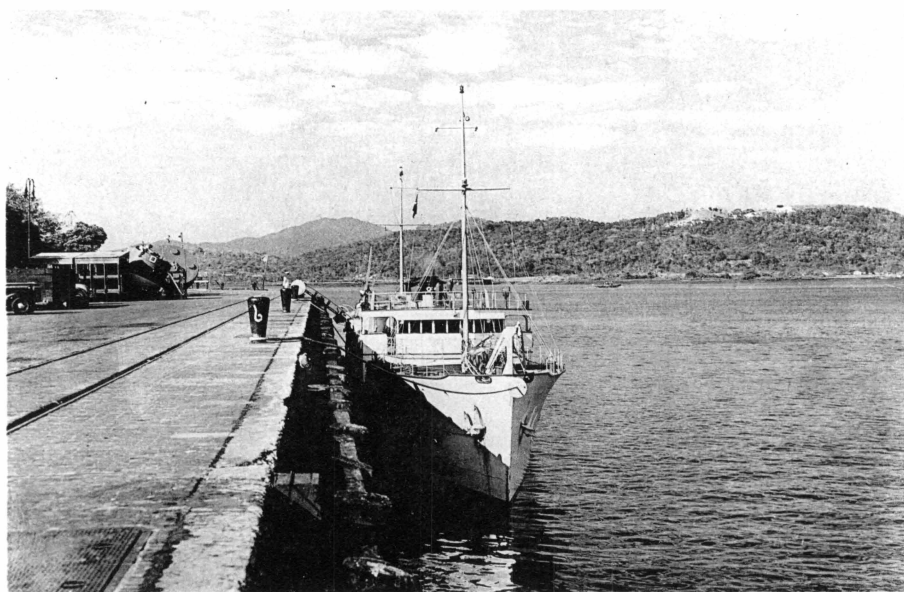


Fig. 179 Balboa, Canal Zone



Fig. 180 Gatun Lake from Barro Colorado Island

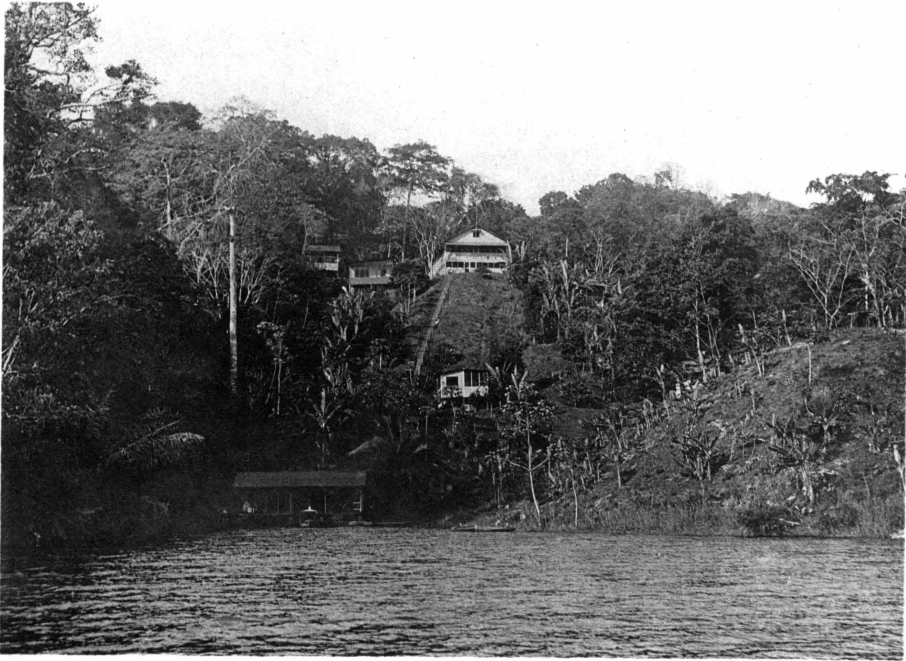


Fig. 181 Barro Colorado Island, Canal Zone



Fig. 182 (*left*) Piñas Bay, Panama
Fig. 183 (*right*) Piñas Bay, Panama
Fig. 184 (*below*) Malpelo Island, Colombia

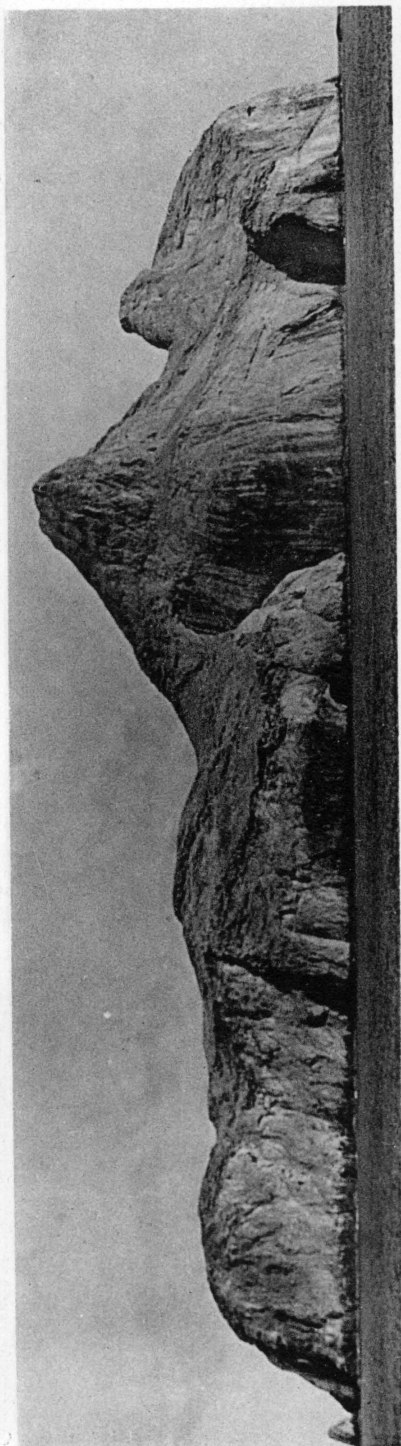




Fig. 185 Entrance to Port Utria, Colombia

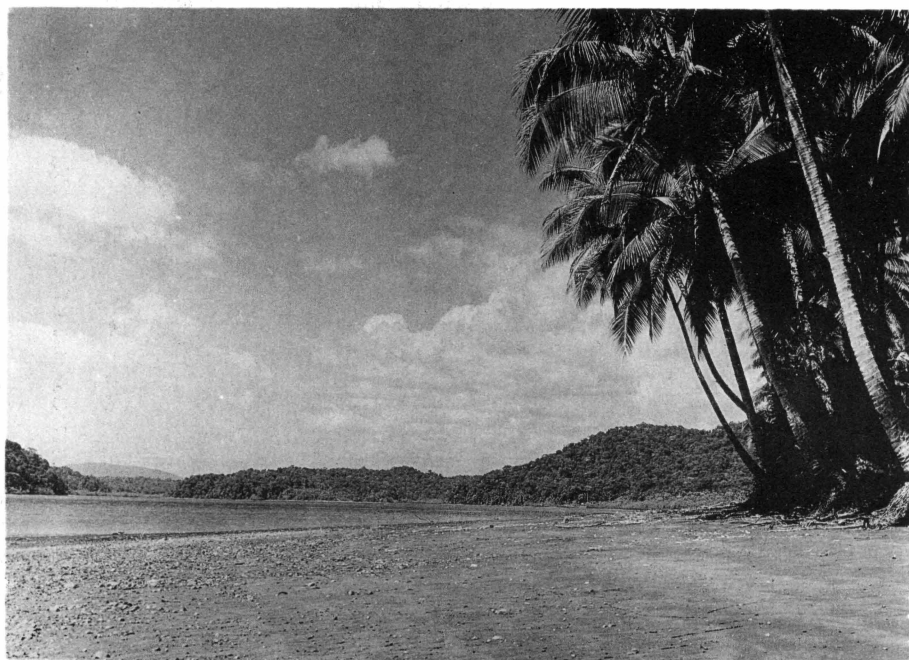


Fig. 186 Port Utria, Colombia

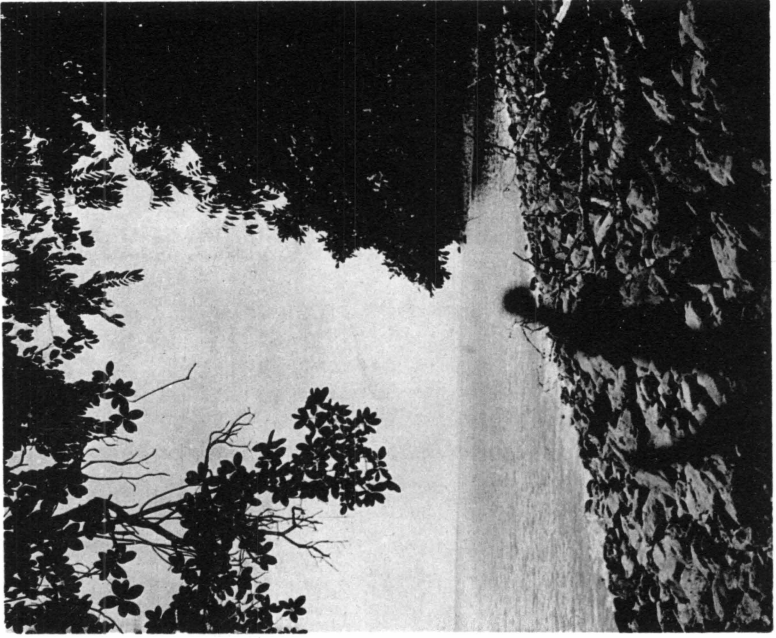


Fig. 188 Gorgona Island, Colombia

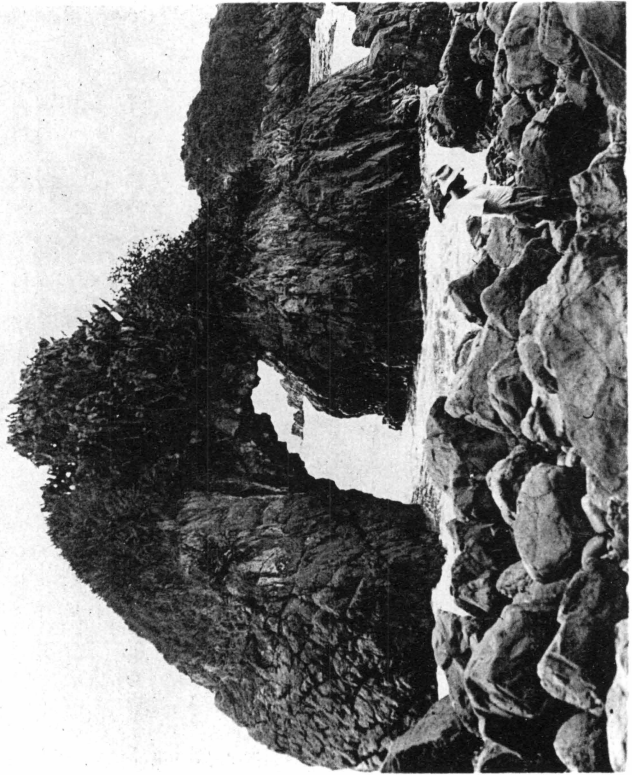


Fig. 187 Gorgona Island, Colombia

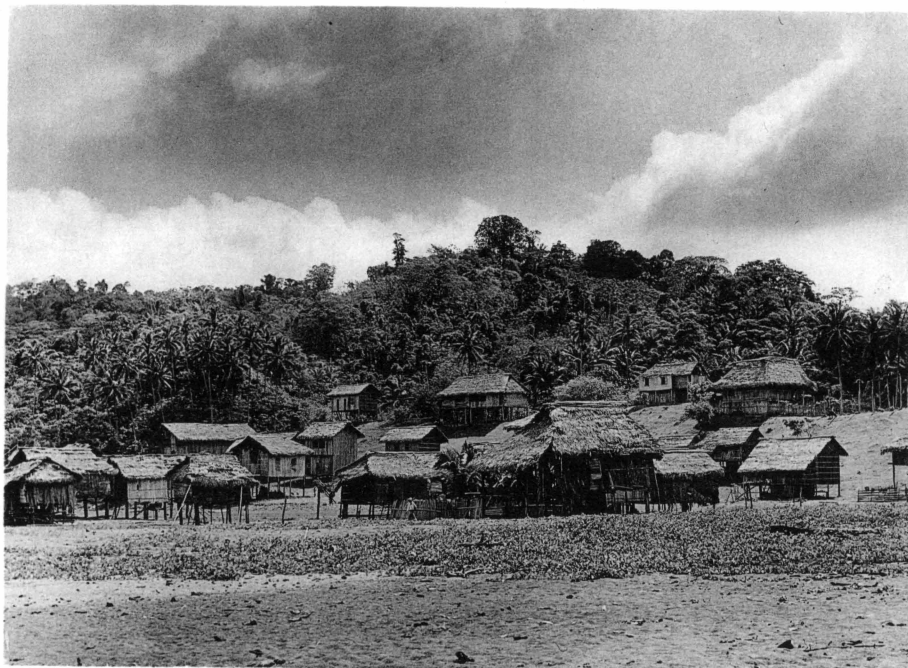


Fig. 189 Village, Cape San Francisco, Ecuador



Fig. 190 Lagoon, Cape San Francisco, Ecuador



Fig. 191 Panorama, Punta Brava, Santa Elena Peninsula, Ecuador



Fig. 192 La Plata Island, Ecuador

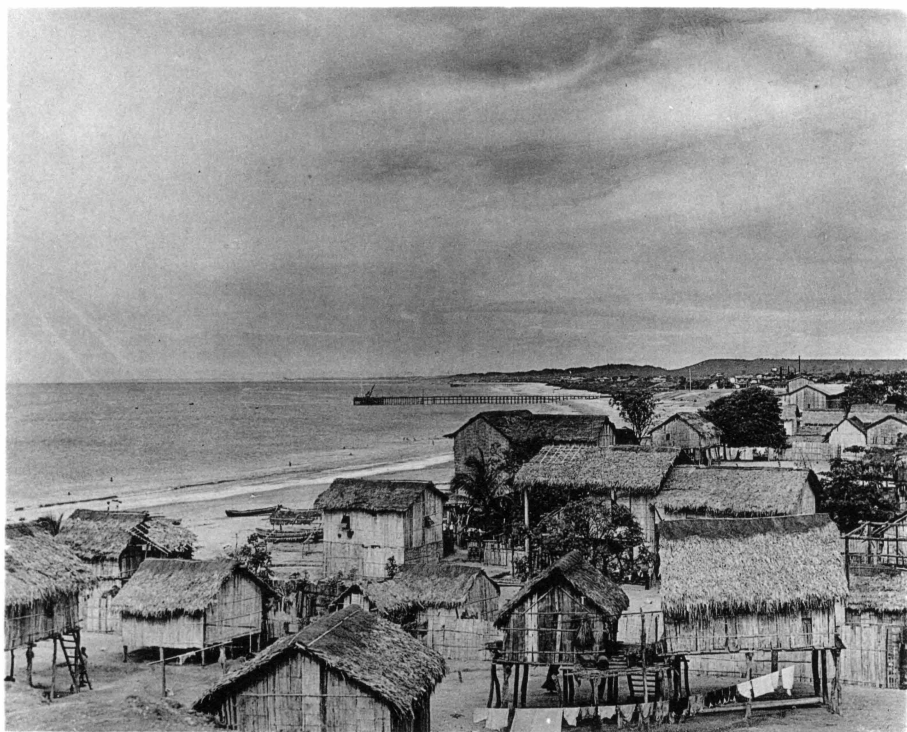


Fig. 193 La Libertad, Ecuador



Fig. 194 Manta, Ecuador



Fig. 195 Guayaquil, Ecuador

PLATE 82

- Fig. 174 The spacious harbor of Bahía Honda, Panama, seen from a slight elevation on the mainland in the northeast portion of the bay. The village lies on an island to the left, and is not shown in the picture.
- Fig. 175 Native huts on the north shore of Bahía Honda, Panama, the homes of Panamanian fishermen. Collecting of marine invertebrates, particularly crustaceans, was accomplished in a small-rock shingle at the far end of the beach. Chart 80, p. 409.

PLATE 83

- Fig. 176 Two views of the exposed reef which extends for a mile or more along a, b the shores of Jicarita Island, Panama, and probably represents an uplifted shore line. Jicarita Island is much smaller than, and is situated south of Jicarón Island. Chart 81, p. 409. (Photographs by Wm. R. Taylor.)
- Fig. 177 The village on Taboga Island, Panama, is not large, but it commands directly the Pacific approach to the Panama Canal. Dredging in the vicinity of Taboga Island was the only offshore operation carried on by the *Velero III* within the Bay of Panama. Chart 82, p. 410.

PLATE 84

- Fig. 178 Water front at Panama City, Panama, taken from near the president's palace. The small boats in the foreground are fishing vessels and fruit boats which bring their produce to the market in the early morning hours. Chart 82, p. 410.
- Fig. 179 The *Velero III* alongside the dock in Balboa, Canal Zone. Vessels making the transit of the Canal pass up the channel directly astern. The clear spaces shown on the hills in the background represent recently burned-over areas. Chart 82, p. 410.

PLATE 85

- Fig. 180 Gatun Lake in the Canal Zone seen from the head of the stairway leading to the Barro Colorado Island laboratories. The route of the canal crosses the picture from left to right about a mile beyond the small island in the center of the picture. (Photograph by W. L. Schmitt.)
- Fig. 181 The New York Zoological Society's Laboratory of Tropical Research is located on Barro Colorado Island in the Canal Zone. The laboratory is reached by crossing Gatun Lake from the Frijoles Railroad Station on the Trans-Isthmian Railroad. The principal laboratory building is shown at the head of the stairway. (Photograph by W. L. Schmitt.)

PLATE 86

- Fig. 182 Stream behind village at Piñas Bay, Panama, showing dense growth of tropical jungle. Chart 82, p. 410.
- Fig. 183 A glimpse of Panamanian shore line at Piñas Bay. The promontory which forms the southern boundary of the bay is shown beyond the figures of the native boys, who in turn are standing beside a large mortar used in grinding flour.
- Fig. 184 The island of Malpelo, Colombia, a solid mass of granite rising from the deep floor of the Bay of Panama. Here Hancock Expedition parties secured examples of the rare lizard, *Diploglossus hancocki*, and of the abundant land crab, *Gecarcinus malpelenis*.

It is desired to make a special acknowledgment to Dr. John S. Garth for his contribution of photographs used in the following figures: 82, 83, 87, 93, 97, 98, 104, 105, 106, 117, 120, 123, 124, 125, 133, 134, 139, 140, 141, 146, 147a, 149, 152, 157, 169, 171, 172, 173, 174, 182, 183, 187, 188, 195, 196, 197, 202, 204, 210, 214, 240, 242, 247, 248, 249, 257, 258.

PLATE 87

- Fig. 185 The entrance to Port Utria, Colombia, is narrow, but deep. Hills are clothed with the luxuriant foliage of the tropical rain forest which extends to the water's edge. The few sand beaches are backed with groves of coconut palms beneath which are located native dwellings. Chart 85, p. 411.
- Fig. 186 Beneath the roots of the coconut palm trees at Port Utria, Colombia, were found giant burrowing land crabs, while the forest in the interior abounded with tropical birds and butterflies. Rainfall in this region is almost incessant. Chart 85, p. 411.

PLATE 88

- Fig. 187 Sea arch located at the north end of Gorgona Island, Colombia. It is one of a series of sea stacks composed of basaltic lava. Chart 87, p. 412.
- Fig. 188 Rocky beach at Gorgona Island, Colombia, overgrown with dense tropical foliage. Chart 87, p. 412.

PLATE 89

- Fig. 189 The village of Cape San Francisco, Ecuador, as little touched by civilization as any visited by the *Velero III*. Elevation of the bamboo and thatched houses to the second-story level is practiced in view of the abundant rainfall and consequent rapid runoff from the hillsides above in rainy periods.
- Fig. 190 The lagoon at Cape San Francisco communicates with the sea by a narrow estuary which is navigable to small craft at high tide. Ecuadorian fishermen sail their tiny fishing vessels into the lagoon and beach them during stormy weather. Chart 88, p. 412.

PLATES 90, 91

- Fig. 191 (A panorama.) Punta Brava, most westerly promontory of the Santa Elena Peninsula, Ecuador. Several ancient shore lines are seen on the promontories in the background. The reef in the foreground was an exceedingly profitable collecting locality for the marine zoologists. (Photographs by W. L. Schmitt.)
- Fig. 192 Hancock Expedition members launching a native canoe through the surf at La Plata Island, Ecuador. Chart 90, p. 412.
- Fig. 193 La Libertad, Ecuador, seaport of the Santa Elena Peninsula, at which ocean-going tankers take on oil from refineries located across the peninsula at Ancon. Native dwellings are constructed of bamboo and thatch and are invariably elevated. Chart 89, p. 412.

PLATE 92

- Fig. 194 Manta, Ecuador, a thriving seaport town of the province of Manabí. Houses are made for the most part of bamboo, which is known locally as Guayaquil cane. Cathedral spires dominate the landscape. Chart 90, p. 412.
- Fig. 195 The city of Guayaquil, located on the Guayas River about 40 miles from its mouth. It is the largest city in Ecuador, and from it a railroad leads to Quito, the capital, 300 miles inland and 9,000 feet high.

Peru

Plates 93-104; Charts 91-97

From Payana Point outward the south-southeastern shore forms the coast line of Peru. Fifteen or 16 miles from Payana Point the appearance of the coastal landscape changes very materially. The rich, green vegetation of the shores of the inner gulf and the north shore almost ceases. What there is, is low and scattered. It is 66 miles from Malpelo Point to Cape Blanco. There is one shore station 24 miles southwest of Malpelo Point and 9 miles from Zorritos Light.

South of Cape Blanco, 25 miles, is Parinas Point, the most westerly point of South America. The intervening coast is made up of two small bights, with Lobos Point between. Here and far south along the coast from here are numerous small bays that serve as anchorages for the many oil towns and villages on or near the coast.

From Parinas Point the coast stretches southwestward to Port Paita and westward again a short distance to Paita Point, 27 miles from Parinas Point. Paita Point is the northwest extremity of a 10-mile peninsula with Foca Point at the southwest extremity. Most of these points along this part of the coast form cliffs, often sandy, or bluffs higher than the coast and extending inland.

From Foca Point the trend of the coast for 30 miles is southeast to the entrance of a semicircular bay, Sechura Bay, 12 miles across the entrance to Pizura Point; or the whole indentation from Foca Point to Pizura Point may be called Sechura Bay. There are two dredging stations in the bay, both in 10 fathoms or less in sand and broken shell, the one 18 miles southeast of Foca Point and the other 10 miles northeast of Pizura Point.

Ten miles south of Pizura Point, where the oil fields are left behind, is Aguja Point, from which the coast line forms a regular convexity facing south for about 15 miles and then forms a regular, low-lying coast extending to the southeastward to Eten Head. Thirty-three miles southeast of Aguja Point and 9 miles offshore is Lobos de Tierra Island, $5\frac{1}{2}$ miles long from north to south and $\frac{1}{4}$ to 2 miles wide, with numerous islets and shoals offshore. The greatest height is 325 feet.

South and somewhat east of this, 28 miles, and 50 miles directly west of Eten Head are the Lobos de Afuera. There are two islands close together and several islets. They are barren, covered with guano, the most northerly of the "Bird Islands of Peru." Much of the shore is inaccessible, but there is anchorage in a bay to the northwest and in one to the

southeast. The birds here are the main attraction, but some shore collecting and dredging in shallow water and rock in both north and south bays have been done.

For more than 100 miles in a south-southeasterly trend, from Eten Head to Huañape Hill, the coast line might be described as wavy, as there are no prominent points and no deep recessions. The coast is low, mostly with a sand beach, but this is occasionally broken by sand cliffs.

Six miles west of south from the point that projects from Huañape Hill are the Huañape Islands, two of them, with some outlying islets and rocks. The islands are small but are high and rocky. Some collections have been made along the rocky shore by making use of a skiff.

With the exception of 30 miles of coast, 45 miles from Huañape Hill, where there are several definite indentations, separated by projecting points, the coast south of Huañape Hill, for 135 miles, to Salinas Promontory is much the same in nature and trend as that north of the Hill. Salinas Promontory projects directly westward. It is 6 miles wide at the face, between Bajas Point to the north and Salinas Point to the west. Eastward of Bajas Point is the fair-sized Salinas Bay. Huara Islands, a chain of small islets, lie 14 miles to the southwest.

From Salinas Point there is a 53-mile sweep of the coast, southwestward, southward, and finally westward to Callao Point, off which is the island, San Lorenzo, which forms the southwest boundary of Callao Bay, the entrance of which extends 11 miles from Cape San Lorenzo, the northern tip of the island, to Bernal Point on the mainland to the northeast.

Callao, the principal Peruvian port, 8 miles from Lima, the capital city, is situated at the head of the bay, facing the northwest.

Callao Point projects a mile or so from the mainland; it is narrow, and the connection with the mainland is but 200 yards wide. From the point a shoal, Camotal Bank, extends westward for $1\frac{3}{4}$ miles, narrowing the real channel between the Bank and San Lorenzo Island, the Boquerón, to little more than half a mile. From the east shore of the bay, just north of Callao, at the mouth of the River Rimac, is another large bank, extending a mile seaward. Except for these banks the bay is free of dangers.

San Lorenzo Island, $4\frac{1}{2}$ miles long, northwest to southeast, and 1 mile wide, with 1,220 feet as the greatest elevation, is separated from Callao Point by the Boquerón. There are several islands, islets, and rocks offshore, particularly off the south end. The largest of these is Fronton

Island, $\frac{3}{4}$ mile long and slightly more than $\frac{1}{4}$ mile wide. A bank from the main island extends around Fronton Island, as it does around some of the other small islands.

There is a shore station on the breakwater at Callao, but in this vicinity all the dredging has been done around Fronton Island and the adjacent portion of San Lorenzo Island.

West of Callao Bay, 37 miles from Bernal Point, is a small cluster of rocks, Hormigas de Afuera, guano covered and without vegetation. Here are two dredging stations, in 45 fathoms, mud and shell.

From Callao Point the coast line continues in the same general direction for 120 miles and then swings westward, 10 miles, to Paracas Point, with a southward indentation east of the point to form Paracas Bay, so that the Paracas Peninsula is cut nearly halfway through at the base. The peninsula is 7 miles wide at the face between Point Paracas and Point Huacas.

North of the peninsula, 10 miles, are the three small Chincha Islands, North, Middle, and South islands. The South Island is the smallest, and the Middle Island is but slightly smaller than the North Island. These islands are most definitely the "Bird Islands of Peru." So much guano has been exported that the height of the islands has materially decreased. Here again, the birds have been the big attraction, but there have been some shore collecting and considerable dredging. In shallow water, in sand, shell, and rock, fair results have been obtained, but in the deeper water, in mud, there is little but hosts of nematodes.

From Point Huacas the coast trends to the southeast and south, 20 miles, to Carretas Head, which extends southward to shut off the northern part of Independencia Bay. This large bay is 15 miles long, but is narrowed to 10 miles at the entrance between Carretas Head and Quemado Point. It is largely shut off from the open sea in its southern portion by the islands Viejas and Santa Rosa, but there is a wide channel, Trujillana Channel, between Viejas Island and Carretas Head. Here the water is much deeper than in most of the bay itself, where it is seldom more than 20 fathoms.

There are shore stations in rock and in sand on the mainland side of the bay south of Tungo Village and on the rocky shore on the east side of the island. Lobster traps have been set and dipping has been effective. There have been about 20 dredging stations off Tungo Village and south of this, east of Viejas Island, in the middle of the bay, in the central and southern portions, and in Trujillana Channel. In the shallow water in

sand, shell, and rock results have been good, but in the mud it is mainly nematodes again.

Seventy-two miles southeast of Quemado Point is Beware (Santa Ana) Point, at the northwestern entrance to Port San Nicolas, a bay 9 miles wide at the entrance, between Beware Point and San Nicolas (Harmless) Point. This latter point projects sufficiently to form a semi-circular bay, 2 miles wide, that forms the southeastern extension of the larger bay. There are one shore station on the rocks near Point San Nicolas and one dredging station about $\frac{3}{4}$ mile east of this, near the south shore of the bay, in 10-25 fathoms, mud.

Southeast of San Nicolas Point is another indentation similar to that north of it, the southern extension, in particular, being similar. This is Port San Juan. The southwest point is San Juan Point, 8 miles southeast of Point San Nicolas. There are two shore stations on the rocks on the south shore of the bay, 2 dipping stations with electric light, and several dredging stations in the southern part of the bay and off Point San Juan, 10-45 fathoms, in sand, shell, rock, and mud.

Port San Juan is the southern limit of the *Velero III* exploration.

PLATE 93

- Fig. 196 (A panorama.) An extensive view of the seaward side of Lobos de Afuera Islands, Peru, showing the lighthouse at the extreme left and a cove in which landings may be made in calm weather only. The nesting birds are pelicans.
- Fig. 197 (A panorama.) Pelican rookery at Lobos de Afuera Islands, Peru. These are the northernmost of Peru's guano islands and are notable for the total absence of the white-breasted cormorant which occurs so abundantly on the more southerly islands. Chart 92, p. 413; Chart 93, p. 414.

PLATE 94

- Fig. 198 The landing place at Lobos de Afuera Islands, Peru, a deep and quiet cove in which live the lighthouse keeper and the guardian of the island, representatives of the Peruvian Guano Administration. Chart 92 p. 413.
- Fig. 199 The principal rookery at Lobos de Afuera contains about 200,000 of the Peruvian pelican. Most of the adult birds were at sea fishing at the time this picture was taken. Chart 92, p. 413.

PLATE 95

- Fig. 200 The island of Huañape, most productive guano island with possible exception of the Chinchas group. Over 3,000,000 guanayes, or cormorants, nest on the slopes of this island. Young guanayes just learning to swim may be seen in the lower right-hand corner.
- Fig. 201 Landing place at Huañape Island, Peru. The considerable rise and fall of the tide makes necessary the rope ladder and the extensible wooden stairway. A small army of several thousand workers descend upon the island every three years and shovel off the accumulated bird excrement.

PLATE 96

- Fig. 202 (A panorama.) A portion of a rookery of over 3,000,000 white-breasted cormorants nesting on the island of Huañape, Peru. Terraces have been built to afford a maximum of level nesting territory.
- Fig. 203 The seaward shore of Mazorca Island is precipitous and rocky. Every available nesting site is occupied by a pair of piqueros, or boobies, but because of the inaccessibility of the nesting sites their guano cannot be reclaimed.

PLATE 97

- Fig. 204 Mazorca Island, Peru, seen from the deck of the *Velero III*. Officials of the Guano Administration are about to greet the Expedition and invite its scientists ashore.
- Fig. 205 The Island of Mazorca, basaltic monolith surmounted by a lighthouse and radio station. The buildings in the foreground are occupied by workers of the Peruvian Guano Administration and are reached by means of the hanging ladders.

PLATE 98

- Fig. 206 The water front at Callao, Peru, showing small fishing vessels which can be propelled either by oar or by sail. Large ocean-going vessels tie up at Callao wharves, some of which may be seen at the left background.
- Fig. 207 The Peruvian coast line south of Callao, marked by sea stacks in various stages of disintegration as represented by the flattened islands at the left, the peninsula in the center, and the outlying rocks, Chart 94, p. 414.

PLATE 99

- Fig. 208 The ruins at Pachacamac, visited by hundreds of tourists annually and included in the itinerary of a party from the *Velero III* at the time of 1938 cruise to Lima, Peru.
- Fig. 209 Expedition photographer surrounded by white-breasted cormorants at Chinchas Islands, Peru. Elevation of Middle Chinchas is said to have been lowered over 100 feet in the removing of its crown of solid guano.

PLATE 100

- Fig. 210 (A panorama.) The north island of the Ballestas group, Peru, taken from near the summit of the south island. The *Velero III* may be dimly seen immediately above a large patch of nesting birds located over the sea cave which is a prominent feature of the middle island.
- Fig. 211 The Ballestas Islands, among the most eroded of the Peruvian guano islands. They support guanayes and piqueros in about equal numbers, the guanayes preferring the more level, the piqueros the more sloping, localities as shown on the promontory to the right. In the distance rises the cloud-enveloped summit of the island of San Gallan.

PLATE 101

- Fig. 212 From the summit of Mazorca Island a magnificent panorama of ocean, rocky shore, and mist-filled valleys unfolds, the Peruvian Andes serving as a backdrop. The birds in the immediate foreground are piqueros, those on the lower slopes guanayes, or white-breasted cormorants.
- Fig. 213 View of Independencia Bay, Peru, taken from the east side of Vieja Island, looking south. The Humboldt penguin burrows into the recent conglomerate stratum of the beach in the foreground. In the left background is the Peruvian mainland. Chart 96, p. 415.

PLATES 102, 103

- Fig. 214 (A panorama.) A view of the peninsula which forms the southern boundary of San Juan Bay, Peru, southernmost locality visited by the *Velero III*. The Peruvian sea lion inhabits the rocky coves shown at the right of the picture, the Andean condor flying above the precipitous bluffs. Chart 97, p. 416.
- Fig. 215 Rugged coast encountered off San Juan Bay, Peru, showing rookeries of the Peruvian sea lion, and large beds of kelp. The rocks in the distance make navigation exceedingly hazardous.
- Fig. 216 San Juan Bay, Peru, most southerly point visited by the Allan Hancock Expeditions. The Expedition launch is about to land at a seal hunters' camp. A desolate portion of the Peru coast line is shown on the other side of the bay.

PLATE 104

- Fig. 217 View of Viejas Island, Peru, looking across the southern channel of Independencia Bay from Santa Rosa Islands. The Santa Rosa Islands are a much eroded, uplifted plain, the summit of which affords nesting sites for thousands of white-breasted cormorants. Chart 96, p. 415.
- Fig. 218 The various islands of the Santa Rosa group are connected by suspension bridges which greatly facilitate the work of the guano harvesters. The islands are the remnants of an uplifted, wave-cut bench.
- Fig. 219 The Santa Rosa Islands, located at the southern end of Independencia Bay, Peru, and devoted exclusively to the culture of the guanaye or cormorant. Across the channel may be seen the southern end of Viejas Island, the summit of which is shrouded in mist.



Fig. 196 Lobos de Afuera Islands,
Peru

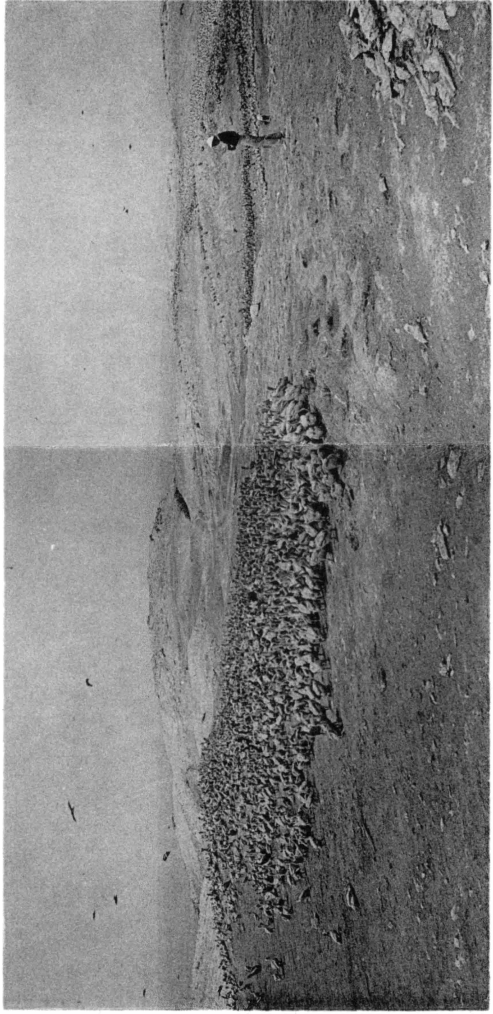
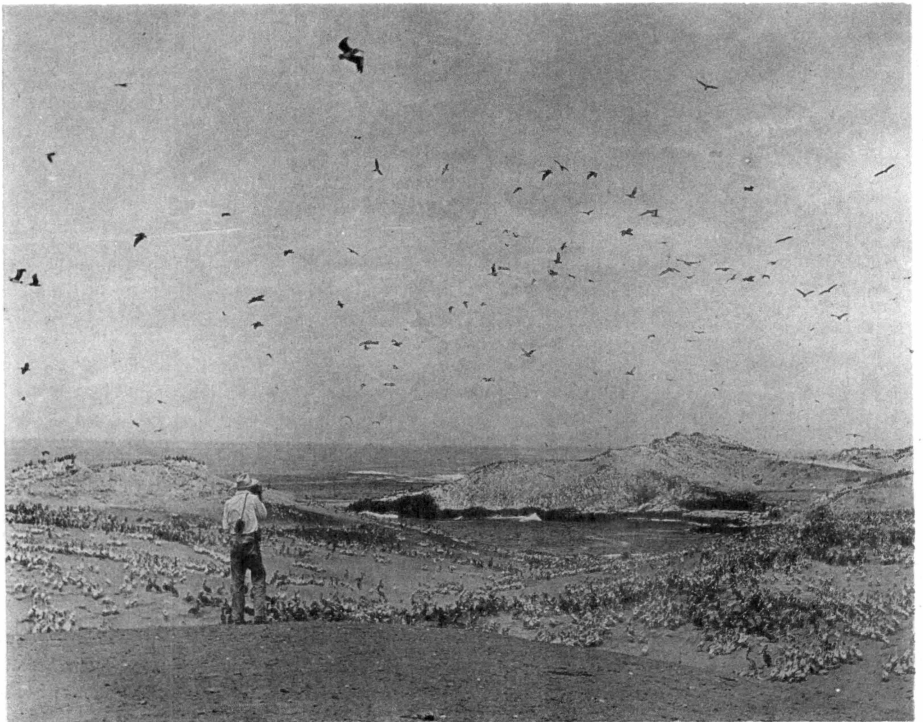
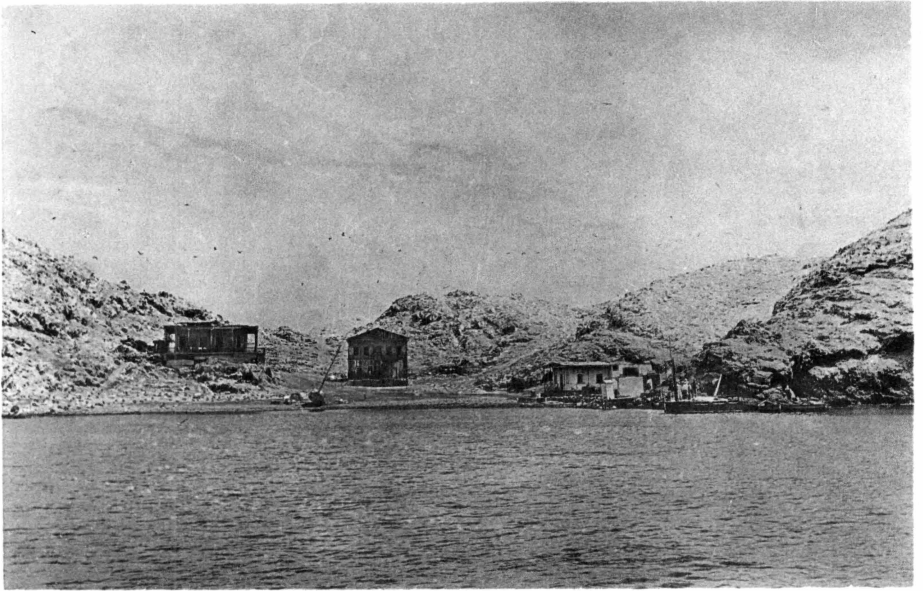


Fig. 197 (*right*) Lobos de Afuera
Islands, Peru, pelican rookery



Figs. 198, 199 Lobos de Afuera Islands, Peru, landing and rookery



Fig. 200 Huañape Island, Peru



Fig. 201 Huañape Island, Peru, landing



Fig. 202 Panorama, Huañape Island, Peru



Fig. 203 Mazorca Island, Peru, rookery and piqueros



Fig. 204 Mazorca Island, Peru



Fig. 205 Mazorca Island, Peru



Fig. 206 Callao, Peru, waterfront

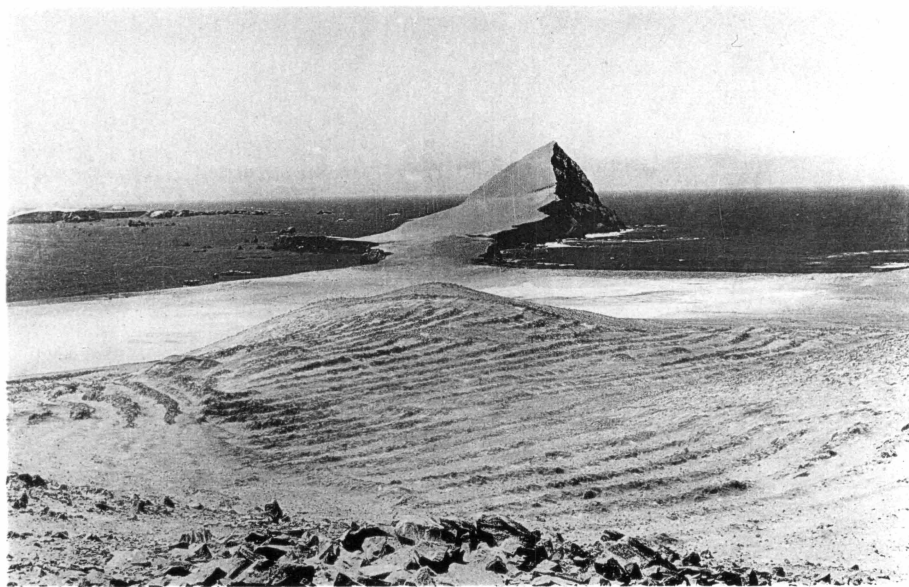


Fig. 207 Peruvian coastline south of Callao

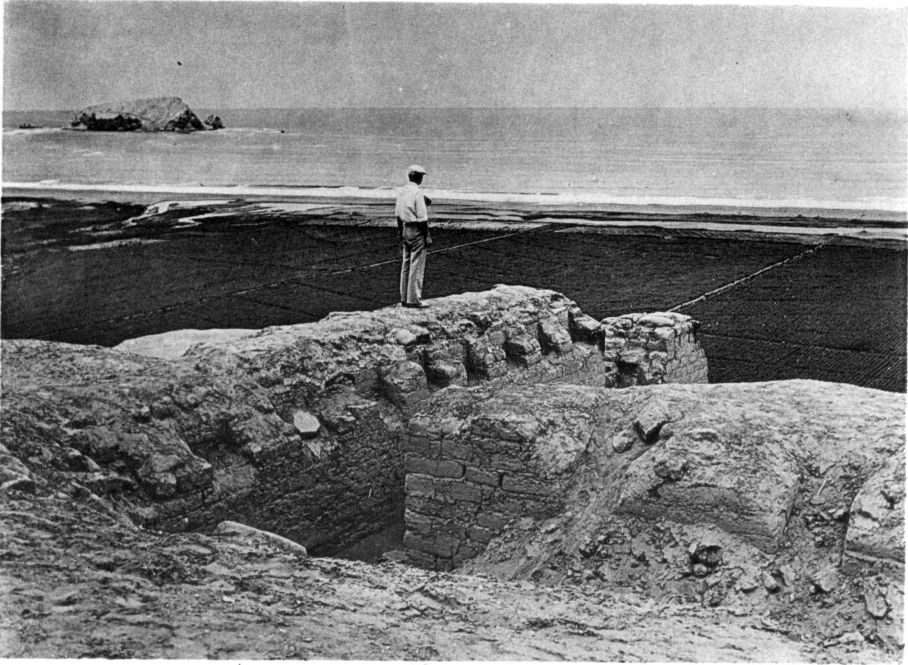


Fig. 208 Pachacamac, Peru, ruins

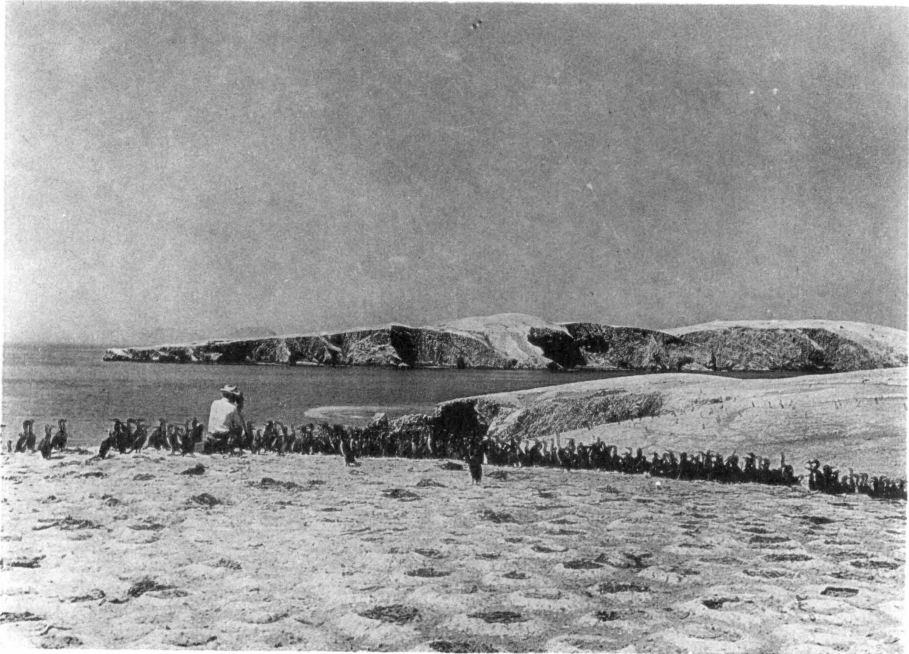


Fig. 209 Chinchas Islands, Peru

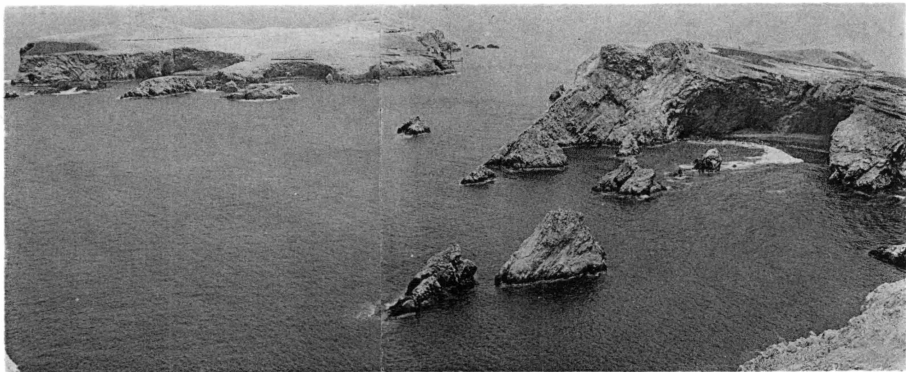


Fig. 210 Ballestas, Peru, north island



Fig. 211 Ballestas Islands, Peru

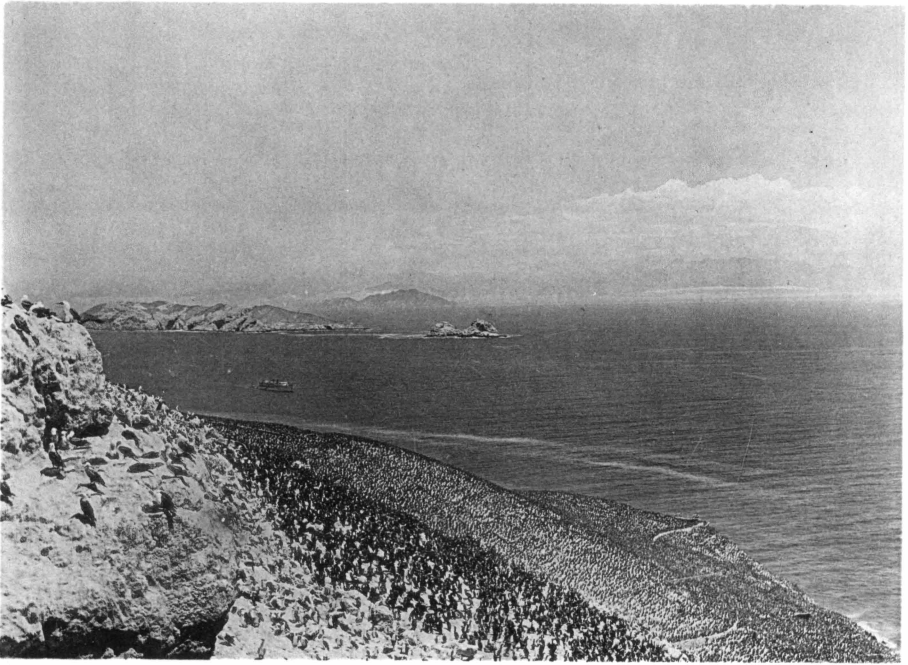


Fig. 212 Rookery, Bird Islands, Peru



Fig. 213 Independencia Bay, Peru



Fig. 214 Panorama, San Juan Bay, Peru



Fig. 215 San Juan Bay, Peru, sea lion rookery

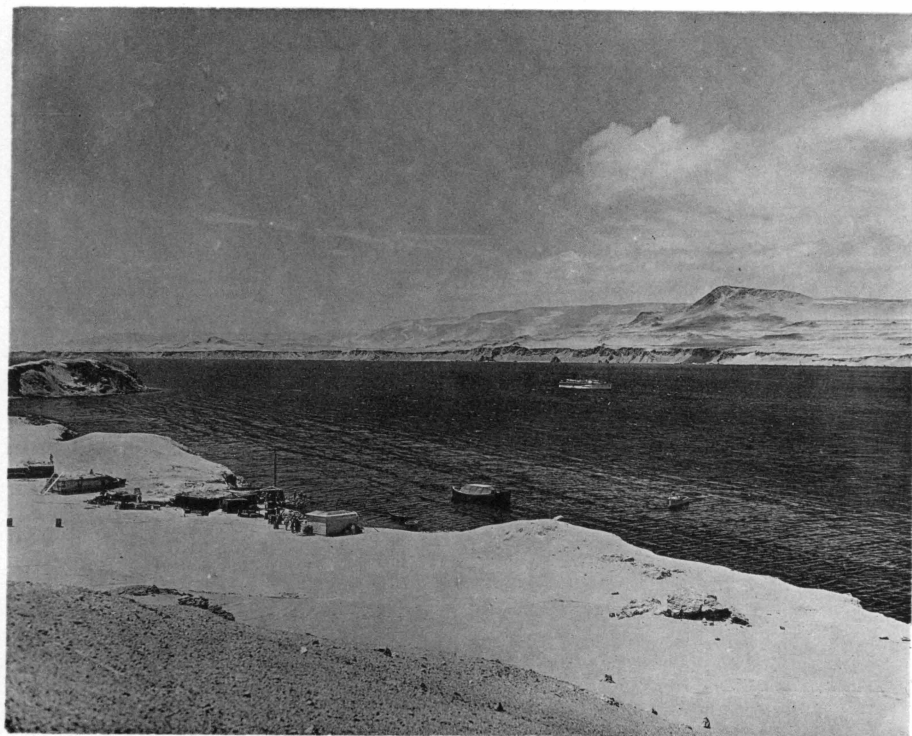
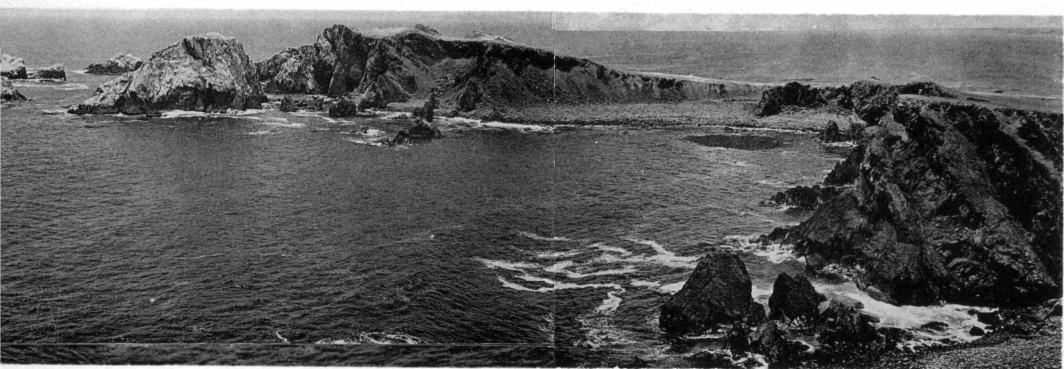
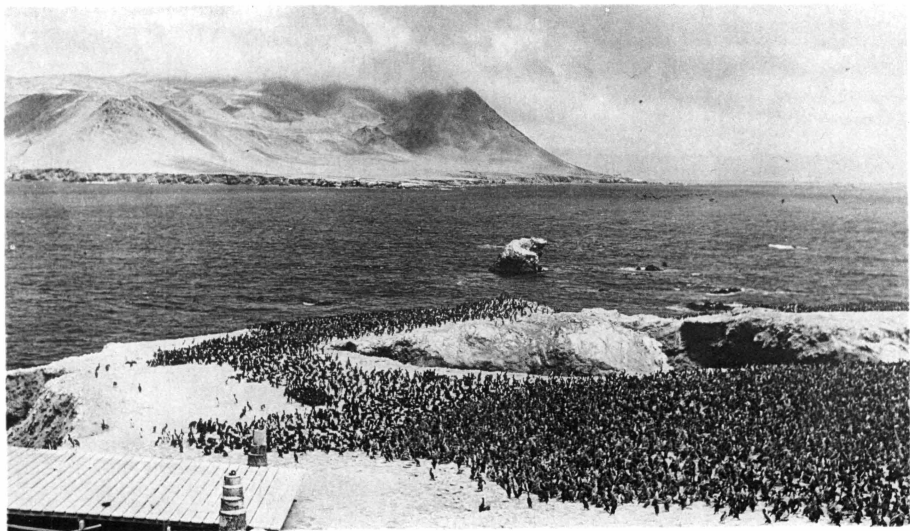


Fig. 216 San Juan Bay, Peru, sea lion hunters' camp



Figs. 217, 218 Santa Rosa Islands; 219 Vieja Island from Santa Rosa Islands, Peru

The Galapagos Islands

Plates 105-128; Charts 98-115

Apart from Culpepper and Wenman islands, which are outliers to the northwest, the Galapagos Islands form quite a compact archipelago, 600 miles from the coast of Ecuador, lying between $0^{\circ} 40'$ North and $1^{\circ} 30'$ South, and between $89^{\circ} 15'$ West and $91^{\circ} 45'$ West. Nearly all the large islands have Spanish as well as English names; one of them has two Spanish names and one English.

The main islands are arranged in three crescents lying in the same general direction. There is a northern crescent, with which Culpepper and Wenman may be included, consisting of Abingdon (Pinta), Bindloe (Marchena), and Tower; a central crescent, including the part of Albemarle (Isabela) north of Perry Isthmus, James (San Salvador), Indefatigable (Santa Cruz), Barrington (Santa Fe), and Chatham (San Cristobal); and a southern crescent, consisting of Narborough (Fernandina), the southern portion of Albemarle, Charles (Floreana or Santa Maria), and Hood (Española). The several small islands are usually adjacent to the larger ones.

All the islands are volcanic in origin, and some of them still show signs of activity or have been active recently. All the larger islands have the same general appearance. Each has one or more volcanic cones, the highest of them up to 5,000 feet. The coastal areas and lower portions of the slopes are dry and barren, the naked lava flows showing, or with more or less complete covering of cactus and prickly or spiny shrubbery, with leaves small or absent, practically devoid of green coloration. Farther up the slopes there may be some moisture or even an occasional spring, while the mountain tops themselves are often beclouded or be-fogged, and so get a share of moisture. In these higher areas the vegetation gets a better chance, and sugar cane, vegetables, and certain fruits, such as bananas and papayas, do very well. The soil formed from the eroded lava is evidently fertile when water is available.

Several of the islands have been inhabited at various times, and some of them are inhabited at present. In ordinary years conditions for a comfortable life in certain locations are quite favorable, but in an unusually dry year existence may become precarious.

At various times horses, donkeys, cattle, and goats have been taken to the islands, and there are still many of them which have gone wild. On some of the islands the goats, in particular, seem to have thrived to the detriment of other stock and indigenous animals that require the same

type of food. The abundance of fish in the near-by seas is possibly the greatest attraction nowadays.

Culpepper Island, $1^{\circ} 39'$ North, $91^{\circ} 49'$ West, marks the northwestern limit of the Galapagos Archipelago. It is a small island, 2 miles long, with the greatest elevation 550 feet. It is reported to be quite inaccessible. The *Velero III* has not visited the island, but passed it, in plain sight, about 10 miles to the westward.

Wenman Island is 20 miles south and east of Culpepper, almost equidistant, 75 miles, from Albemarle and Abingdon islands. It is really a group of three islands, but appears as one even at no great distance. The main island is precipitous, 830 feet high, with a flat top. Although volcanic, the main island appearing to be about half the cone of a large volcano, the rock appears to be laid down in uniform layers, probably formed from successive flows. Although the gaps between the separate islands give some degree of shelter, there is no suitable anchorage.

A shore station on the ledges of rock provided much good material, and birds, marine iguanas, lizards, etc., are plentiful. Dredging opposite the channel between the large island and the smaller island to the north of it, in 100-150 fathoms, in nullipores and worm-tubes, gave good results, although the dead material was large as compared with the living material.

Abingdon Island, the northwestern island of the three main islands of the northern crescent, is $6\frac{1}{2}$ miles long, north and south, 5 miles wide, 1,950 feet high. The shores are precipitous, but in some places there is a sea-level ledge at the foot of the precipice. There are numerous rocks or rocky islets lying offshore. The only reasonable anchorage is $1\frac{1}{2}$ miles north of Cape Chalmers (the southwestern extremity) on the west side of the island. There is a shore station near this anchorage.

Bindloe Island is of much the same type as Abingdon, 8 miles long, northwest to southeast, and 5 miles wide, but with greatest height only 500 feet. It lies $13\frac{1}{2}$ miles to the southeast of Abingdon Island. Here also the best protection is to the southwest of the island. There are one shore station on the rocks and two dredging stations in shallow water, in sand and rock, and a greater number of tangle stations in water up to 20 fathoms, rock.

Tower Island, 27 miles east of Bindloe, is a smaller island, 4 miles long, east and west, and 3 miles wide, not much like the other two. It is low (100 feet) and is far from being as rugged. Its most characteristic feature is Darwin Bay, a break in the south shore near the east end of

the island, $\frac{1}{2}$ mile wide at the entrance, but $1\frac{1}{4}$ miles wide farther in and nearly circular, with the water deepening rapidly from all the shore and becoming very deep. Most of the shore is rocky, but there is a beach on the north side of the bay. There are a small pond near the beach and a much larger one, apparently filling, or partly filling, an old crater, about a mile north of the north shore of the bay.

There are shore stations on the rocks, in the sand, at the shore lagoon and the crater lagoon, several for collecting coral masses, for diving, and for dipping under the electric light; and there are dredging stations in sand, rock, and coral, from 5 to 70 fathoms.

In 1933 the *Velero III* rediscovered the Galapagos Fur Seal at Tower Island. Sea lions are common here as well as at many of the other islands.

Narborough Island really belongs to the southern crescent; but, as it faces the concavity of Albemarle and is but 3 miles from it in the northern portion, it may well be taken here. It is almost the same in length and breadth, 16 or 17 miles, and it has but one large volcanic cone, 4,320 feet, not far from the center of the island. The slopes are quite steep in the upper portion, but more gradual in the portion toward the sea, so that a large part of the island is comparatively low. There has been violent activity on this island more recently than on any of the others, as recently as 1926. The lava flows to the east, southeast, and south of the main cone seem so fresh that they might have just cooled.

There are numerous indentations along the northeast shore of the island, almost, or entirely, shut off to form salt-water lagoons, some of which are much filled with mangroves. Sea lions and turtles are partial to these lagoons. The marine iguanas are numerous along this shore. The shore and land birds are plentiful but are not different from those on the other islands. One shore station is made to include collecting along the ragged rocks, in the tide pools, in the lagoons, and among the mangroves.

Albemarle Island is the largest in the archipelago, and in some respects the most interesting. It is shaped somewhat like a sock, with the foot a little broader than the leg. While the greatest length from north to south is about 75 miles, the leg, measured from the top to the heel, northwest to southeast, is 65 miles; and the foot, from the heel to the toe, northeast to southwest, is 45 miles. The greatest width of the leg is 18 miles, and of the foot 22 miles. Where the leg joins the foot, there is a strong constriction, Perry Isthmus, to a width of 5 miles, from Elizabeth Bay on the west coast to Cartago Bay on the east coast.

Perhaps no other area in the world, at least within easy reach, equals Albemarle Island as a demonstration of the various phases of volcanism. The other islands give some good illustrations, but, in this respect, Albemarle stands supreme. It consists, in the main, of five large volcanoes, or volcanic cones: three in the leg, 4,000, 4,000, and 3,780 feet; and two in the foot, 4,230 and 5,000 feet. Perry Isthmus is of low altitude, but the other valleys are much higher. Some of these cones are still active, but not violently so.

In many places the lava flows are still exposed from the crater rims down to the sea. On all slopes of the large cones there are innumerable cones and craters of all sizes. They are most pronounced on the northwestern slope of the northern volcano and on the western slope of the most southwesterly one. Adjacent to the sea, on the northwestern part of the island, many of the craters are incomplete, the seaward portion missing. Probably by some catastrophic action after the cones were formed, great portions, sometimes as much as half the cone, were split off, leaving a vertical section exposed. When the section is directly through the blow-hole, it may give a perfect demonstration of the way in which the cone was built up, layer after layer in such noticeable stratification that it appears to be diagrammatic. When a large crater is exposed, it may show secondary or even tertiary cones within the crater.

The northeastern slope is much more gradual, down to Albemarle Point, the northeastern point of the island. This is true also of the southeastern slope.

The western slope of the southwestern cone, extending down to Cape Christopher, has so many cones, crowded and interspersed, that the appearance is fantastic in the extreme. It would be impossible to count these cones except from the air, and even then there are so many secondary and tertiary cones, some of them rather small, that it would be a difficult matter. Apparently most of the cones have been formed from the fluid or semifluid lava, as there appear to be few, if any, ash or cinder cones.

Because of all this seismic activity it is quite impossible to give in a few words any general description of the shores of such a large island. A large proportion of it is raggedly rugged, but it may be high or low. It is so rugged and so much of it is exposed so directly to the heavy surf, the Cape Christopher area, for example, that it is unsafe to try to make shore under any circumstances. There are numerous reefs and rocky ledges, but few sandy beaches. There is one small one south of Albemarle Point, at the northeast corner of the island, and some small ones in Cartago Bay, but here the mangrove has spread out so much that there is little of them

exposed. There is a bay at each end of Perry Isthmus, Elizabeth Bay to the west and Cartago Bay to the east, and a bay on the west coast, Banks Bay, just south of Cape Berkeley, the northwest point of the island. There is no very safe anchorage in any of these; but there is one in Tagus Cove—a small, funnel-shaped inlet, shut off from the open sea by the north end of Narborough Island.

There are several small islands near the coast, the most noticeable being Redondo Rock, 14 miles off the north shore; White Rock, white with guano, off the entrance to Cartago Bay; and Crossman Islets and Tortuga Island, off the southeast convexity of the island. Near the head of Tagus Cove there is a saline lake in an old crater.

There are many collecting stations on or near Albemarle Island. Near the northeast point of the island, Albemarle Point, there has been collecting along the rough, rocky shore, in the tide pools, and among the mangroves in the small lagoon. There are an abundance of birds, some marine iguanas, and sea lions. One attempt at dredging in the shallow water was not much of a success. South of Cape Berkeley, at the northern entrance to Banks Bay, the rocky shore has been explored, and again at Black Bight at the southern entrance of this bay. Here also there has been dredging in 12 fathoms, rock. A short distance north of the northern entrance to Tagus Cove, there is a reef near the shore, with the surface exposed only at low spring tide. This has provided some good collecting. Tagus Cove has been a favored location; there have been 26 stations in or near it. The shore stations are on the rocks on both sides of the cove. On the west shore there are some interesting aggregations of solitary corals, forming almost as dense masses as the colonial corals do. There is one station on the shore of the near-by saline lake. At anchorage the electric light reveals a most interesting marine world. The plankton is plentiful and varied; many of the specimens are large enough to be seen readily. The large, graceful flying fish provide much of the visible motion to the picture, which may be quite a peaceful one until the ubiquitous shark intrudes.

The dredging stations from near the head of the cove to well out in the channel between Albemarle and Narborough provide a gradation from sandy bottom, in 10 fathoms or less, near the head, where such sand-loving species as *Amphioxus* are found, out through a coralline and nullipore bottom in 10-50 fathoms to the channel depths of 75 fathoms in rock.

There is one shore station 2 miles south of Tagus Cove, and there are no more until Cape Christopher. Here the shore is so rocky and broken and the surf is so violent that the collection is a scanty one.

On the east coast Cartago Bay provides all of the stations. Most of the shore stations are near where the rock and sand meet, near the northern entrance of the bay, but there is one station on the south side near the head. There is so much mangrove growing out from the shore in much of the bay that it is a difficult matter to make even a near approach to the shore. Much of the main part of the bay is shallow, with sandy bottom liberally sprinkled with patches of rock, and is not very satisfactory for dredging. At the entrance to the bay, and farther out, there is a nullipore bottom, and farther out still, near White Rock, there is mud. The electric light has been used several times at anchorage, but the plankton is not so interesting or so varied as it is at Tagus Cove.

James Island, 10 miles east of Albemarle and 10 miles south of the equator, is nearly rectangular, with greatest length from east to west, 20 miles, north to south, 12 miles. It has one high peak, 2,700 feet, near the center of the island; but other cones of considerable size make it quite rugged, particularly on the western slope, but not so much so as some sections of Albemarle. In the northeast the slope is more gradual, and there is a rather large area of low altitude near shore. The western slope, in general, is green and well wooded, the trees larger than on the other islands. On the western slope of the main peak, at a height of about 1,000 feet, there is a crater that contains a saline lake, from which salt has been obtained. The northern and eastern slopes are much more arid. The basal rock is a rough lava of the "aa" type, but over this, in places, there have been what appears to be three distinct, liquid lava flows: one, possibly the oldest, is reddish brown, somewhat like the basal lava in appearance; another is light gray; and the third is almost black. These give a distinctive appearance to that side of the island.

There are two sizable bays extending into the shore of the island, James Bay on the west side and Sullivan Bay at the north end of the east side. Off the northern portion of the west side is Albany Island, separated from James by a deep channel, $\frac{1}{4}$ mile wide; and off the northeast corner of the island is a somewhat larger island than Albany, Bartholomew Island, the channel between, at its narrowest, being less than 300 yards wide. As it extends to the northeast, it forms part of the boundary of Sullivan Bay.

Bartholomew is a picturesque little island. It consists of two main portions, east and west, joined by a neck of land, bordered by a sand beach on each side, the south beach backed by sand dunes. Most of the central portion of this neck is occupied by a mangrove lagoon. The larger, eastern

portion reaches a height of 340 feet, as a volcanic cone, much of the base of which, toward the sea, has disappeared. The numerous small cones and craters give it the appearance of the southwestern portion of Albe-marle in miniature. Many of the smaller craters broaden as they go down and have fine volcanic ash in them, as though they had recently been used as fireplaces. They may be as small as 10 feet high and 4 or 5 feet across the mouth of the crater.

The western portion is lower; but toward the Sullivan Bay side a single, huge rock, 50 or 60 feet high, narrowed almost to a point above, but otherwise precipitous with almost perpendicular sides, is broken off sheer from the remainder and makes a very distinct and picturesque landmark. It forms the central figure of a picture which, seen from out in Sullivan Bay, is possibly the most attractive in the Galapagos.

Except for the small sand beaches on Bartholomew Island and one on the shore of James Bay, the shore is wholly rocky and rugged. Just back of the beach at James Bay there is a lagoon, where a flock of flamingoes make their home.

In the James Bay region there are shore stations south of the southwest entrance of the bay on rocky ledges, on rock in the southern portion of the bay, on the beach near the lagoon, and on the shore of the lagoon itself. One is situated on the shore of the salt lake in the interior. There are three dredging stations off the north entrance of the bay between the main shore and Albany Island, from 30 to 75 fathoms, the deeper water being well in the channel, where there are rock and shell. The results have been satisfactory.

All other stations are in the Sullivan Bay area. Shore stations near the rock column on Bartholomew Island, on the shores of the narrow part of the channel, and along the main shore of James Island near the entrance to the channel, where large coral masses were obtained on the ragged, rocky shore, provided good collecting; but the beach on the south side of the neck of land and the lagoon were not so good. There is good dredging in Sullivan Bay in the shallower water, in rock bottom, when the rock is not too rough, as it is liable to be farther out in deeper water off the entrance.

Jervis (Rabida) Island is a small, rugged, barren island, 4 miles south of James Island, with very little vegetation. Although it is only $1\frac{3}{4}$ miles long, it has a height of 1,050 feet. It is not readily accessible, but in fair weather a landing may be made on the northwestern side of the island. The island has not been visited. Dredging in 145 fathoms was attempted without success at a point 4 miles east of the northern part of the island.

Indefatigable Island is the central island of the archipelago, 10 miles from James, 10 miles from Barrington, 15 miles from Albemarle, and 27 miles from Charles. It is the second largest island in the group, somewhat rectangular, 23 miles from east to west, 18 miles from north to south, with an additional narrow projection extending northward 5 miles toward South Seymour Island. It has but one important elevation, near the center, 2,296 feet. The smaller cones are not very numerous. The slope in the upper part is more rapid, but there is a flattening in all directions toward the coast. The lower portions are arid, of the regular Galapagos type; but on the steeper parts of the slopes, although it does not reach the summit, there is much greener vegetation.

There is little sandy beach, or beach of any kind; almost all of the shore is rugged and rocky. There are two bays, Conway Bay to the northwest and Academy Bay near the center of the south shore. Of the islands lying off the coast, the largest is Duncan (Pinzon), 6 miles to the westward. It is somewhat ellipsoidal, 3 miles by 2 miles, with a height of 1,300 feet, with dense, almost impenetrable vegetation. It has been a prominent feature in several expeditions, largely because of the extensive and intensive galápagos hunting that has taken place. Now the Duncan Island species is almost, if not entirely, extinct. Some inland collecting has been done here and some coral masses have been obtained.

North Seymour and South Seymour islands with the *Daphne* group will be considered later.

Eden Island lies at the southwestern entrance to Conway Bay, and Gordon Rocks lie $1\frac{1}{2}$ miles east of the eastern point of the island.

In the Conway Bay region there are shore stations on the mud flats of Eden Island, on the rocks of the main island shore near by, and near the northern entrance to the bay; a dipping station at the anchorage; and one dredging station in 8 fathoms, sand, near the center of the bay. There are several stations in the vicinity of Academy Bay, some shore stations on the north shore of the bay, at the landing and east of it; electric light stations at the anchorage; dredging stations, well inshore in 8 to 12 fathoms and farther out in 15 to 25 fathoms (where algae are unusually abundant for the Galapagos). There are a coral mass station at the shore at Gordon Rocks and three dredging stations not far away, in 20-45 fathoms, rock. There is one deep station, 15 miles east of Gordon Rocks, in 392 fathoms, sand.

Mention has been made of the slender northward extension of Indefatigable Island. This projection reaches out past the boundary of the

island, but it is cut through by two narrow channels, to leave South Seymour and North Seymour islands, extending for another $5\frac{1}{2}$ miles northward. The islands are both low and flat, with much of the surface easily traveled, but there are areas of broken lava rock and low boulders that make it rough. The vegetation is sparse, cactus being most conspicuous, made more sparse by the activities of the numerous goats that roam the islands, or, at least, South Seymour. South Seymour is the home of a large species of land iguana, of a reddish brown color that blends very well with the color of the lava rock where it lives.

There are strong tide rips and crosscurrents around and north of the islands. Most of the shore is rocky, but on the west shore of South Seymour there is a sand beach, probably the largest and finest in the archipelago, with the most conspicuous faunal feature, the large burrowing hermit crab, which leaves trails everywhere in the sand when the tide is out. On the shores of a small bay (which has been named Velero Bay) near the north end of the west coast of South Seymour, there is an interesting fossil-bearing stratum exposed.

Two rocky islets, Daphne Major and Daphne Minor, lie offshore to the westward, a short distance from South Seymour. They are precipitous and conspicuous. It is only with difficulty that a landing can be made on either of them. They increase the channel area in this region.

Collecting in the Seymour Island region has been confined to the west side of the islands and the adjacent waters. There are shore stations on the rocks of North Seymour, in Velero Bay, on the rocks and on the sand beach of South Seymour; inland collecting; several electric light stations; and dredging stations in shallow water, mostly in sand or in sand with rock patches, all along the west coast of both islands and in deeper water, up to 80 fathoms, in shell and rock in the channel between the Daphne Islands and South Seymour. The results from the deeper dredging have been gratifying, since several species were obtained here that did not appear in any of the other Galapagos collections.

Barrington Island, 10 miles southeast of Indefatigable Island, is a rugged island, 6 miles long, east and west, and $3\frac{1}{2}$ miles wide, with a height of 900 feet. Its shores are so precipitous that landing is difficult except at the southern end of the east coast, and even here the anchorage is poor. On the southeast shore there are shore stations on the rocks and among the coral masses, and a diving station in 2 fathoms. There are one dredging station in shallow water near by and others in deeper water, 45 to 75 fathoms, 2 miles and 6 miles north of the island.

Chatham Island, 27 miles east of Barrington, lies with its main axis 24 miles long, northeast and southwest, and is 8 miles wide, with two main peaks nearer the west end, 2,490 and 1,927 feet, with a saddleback connecting them. There are other cones of considerable height, making both ends of the island descend quite abruptly to the sea. There is a better fresh-water supply on this island than on any of the others in the archipelago, so that there is richer vegetation, particularly toward the summit of the hills. Some land is under cultivation, and there is a town, Progreso, the capital of the Galapagos, located on the saddleback between the two summits, 5 miles from the shore at Wreck Bay.

The coast is more irregular than it is on the other islands, as there are more projecting points and indenting bays, some small islands, and many outlying rocks and reefs. The most conspicuous, rocky islet, Kicker Rock, at the entrance to Stephens Bay, 2 miles off Bassa Point, looks as though it were composed of a few very large boulders. It is 486 feet high. Dalrymple Rock, 62 feet high, off Lido Point at the entrance to Wreck Bay, also stands out clearly.

Of the bays, three should be mentioned. Wreck Bay (Porto Chico) is on the north shore, near Wreck Point, the western tip of the island. Here there is a safe and well-protected anchorage, but there are so many shoals and reefs on each side of the entrance that the passage may be difficult in bad weather. It is the main port of the island, the only port of call for vessels coming to the islands from Guayaquil. This is one place in the Galapagos where one may see a wharf or pier. Lido Point stands out prominently at the northeast entrance.

From Lido Point to Bassa Point, the western limit of Stephens Bay (Puerto Grande), there is a ragged coast line. Stephens Bay offers a good anchorage, with safe approach. The entrance, from Bassa Point to Finger Point, is 5 miles across, and the depth of the bay is 2 miles. There is a farther extension of the bay to form Sappho Cove, but here the bottom is strewn with large boulders, and, in consequence, the cove is not suited for anchorage.

On the south side of the island there is a bay or, better, an open roadstead, Freshwater Bay, into which a fresh-water stream empties after a fall over a lava cliff. There is little or no shelter for boats.

On Chatham Island there are two inland stations—one on the shore of El Junco Lake, not far from Progreso, and the other $\frac{1}{2}$ mile upstream from Freshwater Bay. The shore stations, all on rock, are located at Bassa Point, in Wreck Bay, west of Wreck Bay, toward Wreck Point,

and in Freshwater Bay. The dredging stations are at the entrance of Stephens Bay, farther out than Kicker Rock, in 32-40 fathoms, sand and coralline, and in shallower water, 8-12 fathoms, at the entrance to Sappho Cove, where the large boulders on the bottom made dredging difficult. Here gorgonids are at their largest and best. There is one station, about 3 miles offshore at Freshwater Bay, in 400 fathoms, coarse sand.

In the southern crescent, Narborough Island and the southern part of Albemarle have already been discussed. As no dredging, and very little shore collecting, has been done at or near either of them, they do not come into the distribution picture. The two remaining islands, Charles and Hood, have received much attention. They show very well the greater effect of the Humboldt Current than do the islands in the other two crescents. In the swing of the Humboldt Current north and south in seasonal succession, these islands are seldom, if ever, outside the influence of the current.

Charles Island lies midway between Albemarle and Hood islands, 35 miles from each, 27 miles south of Indefatigable Island. It is about 10 miles long, east to west, and 7 miles wide. There are two rather large volcanic cones, 1,500 and 1,780 feet, toward the southern coast, both visible from the western approach to Black Beach Anchorage. The slope to the north shore is quite gradual, and there are few secondary cones. There are some springs on the island, but they do not supply enough water for irrigation, except to a limited extent. In very dry seasons, like that in 1934, they may nearly dry up. There is vegetation on much of the island, with a greater relative number of trees and shrubs, as compared with cactus, than on some of the other islands. There is suitable stock fodder; cattle, goats, pigs, and donkeys are said to be somewhat abundant on the island.

What few sand beaches there are, at Black Beach, Post Office Bay, etc., are very small. The south shore is high and abrupt, the remainder lower and more irregular, with rocky points, islets, and reefs outlying. The chief islands, none of them large, are Onslow Island, off Cormorant Point to the north, and Caldwell and Gardner islands to the southeast. The bays are rather insignificant, none of them offering much protection in a storm; but, since storms are rare, they serve as good anchorages. Black Beach Bay on the west coast, just north of Saddle Point, is a small bight, with a pocket, sand beach that is protected by the rocks enough to make a good landing place. There is much algal growth in shallow water near the rocky shore, but farther out the bottom is sandy.

Post Office Bay is on the north coast, just east of Daylight Point, the northwest point of the island. It is $1\frac{1}{4}$ miles across at the entrance and extends inshore $\frac{3}{4}$ mile. The inner part of the bay is pretty well free of obstructions, but there are shoals and reefs at both sides of the entrance.

Lying just east of the point (not named on the chart) that bounds Post Office Bay to the east is Cormorant Bay, extending $\frac{3}{4}$ mile to Cormorant Point. At the head it is divided into two by a projecting point near its center. Back of the head of the bay there is a salt-water lagoon, inhabited by a flock of flamingoes.

There has been some inland collecting, particularly at the springs near Black Beach and near the south side of the island. There are numerous shore stations on the west coast south of Saddle Point, on the rocks and in the tide pools around the point that forms the southern limit of Black Beach, on the north shore of Black Beach, at the head of Cormorant Bay, on the shore of the salt lagoon east of Cormorant Point, and on Onslow Island, where coral masses were obtained. There are several electric light stations in Black Beach Anchorage and in Post Office Bay. There are dredging stations in shallow water, 4-6 fathoms, and farther out in 35-40 fathoms, in and off Black Beach Bay, several in Post Office Bay, and one in Cormorant Bay. Northwest of Post Office Bay there are three stations, 5 miles from Daylight Point in 40-45 fathoms, 7 miles in 65-70 fathoms, and 10 miles in 250 fathoms.

Between Charles, Indefatigable, and Albemarle islands there is a wide open space in which there have been but few soundings and much fewer bottom indications. This makes dredging here a matter of groping in the dark. To make matters worse, there are strong currents, varying so much in direction and force that the dredge may be carried as many as three different directions in sinking from the surface to the bottom in the deeper portions of this area. There may be quiet periods with little current, but the currents have not been studied; so it is impossible to know when the quiet periods are likely to come. In spite of the difficulties, some stations have been established in this area, most of them between Charles and Indefatigable but one between Charles and Albemarle, in depths ranging from 60 to 200 fathoms. In some of them the material obtained was not very extensive, but there was always something of great interest from the distribution standpoint.

Hood Island, the most southerly of the islands of the archipelago, is elliptical in shape, the long axis, 8 miles, running east and west, and 5 miles wide. It has no high volcanic cones, the highest being 640 feet. The

slope to the north and northeast is gradual. There is more vegetation on it than on some of the others. Most of the shore is rocky, but there is a long, sandy beach facing Gardner Bay.

There is only one outlying island of any size, Gardner Island, lying $\frac{3}{4}$ mile east of the northeastern portion of Hood Island. There is deep enough water in the channel for large vessels to pass through, but off the northern entrance, in Gardner Bay, Magicienne Rock is but 14 feet below the surface, and right in the channel is a small island, Osborn Island. The water is very shallow between Osborn and Hood, but is deeper between Osborn and Gardner. Gardner Island itself is steep and rocky on its western side, but the descent to the beach to the northeast is low. Gardner Bay, the only significant bay off Hood Island, lies between Hood and Gardner islands.

The Gardner Bay region has a rich fauna, possibly as rich as any explored in the Galapagos, and, in consequence, much collecting has been done here. There are shore stations on Gardner Island, on Osborn Island, and on the main island at the head of Gardner Bay and at the northwest entrance to the bay. There are diving stations off the Hood Island shore and electric light stations at the anchorage in Gardner Bay. There are dredging stations in many parts of the bay from shallow water, 2-4 fathoms at the head to 30-50 fathoms at the entrance, and farther out in 50-100 and 140-160 fathoms, mostly in sand but some rock. There is one station 8 miles southeast of the island in 300 fathoms, sand and rock.

Little has been said concerning the distribution of such species as the galápagos, the sea lion, the marine iguana, and various sea and land birds among the islands; but these have been written up at length in so many reports that it does not seem necessary to go into detail concerning them here. Observations have been made on them and these have been recorded. In general, though, these do not come within the range of marine biology.

The Galapagos Archipelago has been, and is, of very great interest. Even the preliminary exploration of the marine fauna and flora has proved to be much worth while. As the material collected is being examined, a more definite basis for further work is being established.

PLATE 105

- Fig. 220 Hancock Expedition members landed at Wenman Island, Galapagos, by means of the rocky shelf shown in the foreground, and made their way precariously up the almost perpendicular basaltic lava cliffs to the flattened summit of the headland. The island is the nesting site of fork-tailed gulls, man-o'-war birds, and boobies. (Photograph by H. W. Manter.)
- Fig. 221 The precipitous sides of Wenman Island, Galapagos, suggest that it is the remnant of a volcanic crater. The landing was effected inside the flat-topped headland shown at the center of the picture. Dredging operations were conducted at a depth of 100 to 150 fathoms near by. Chart 100, p. 417.

PLATE 106

- Fig. 222 Marchena or Bindloe Island, Galapagos, showing lava flows which seem so fresh that they might have cooled but yesterday. They have blotted out every vestige of plant life, except perhaps on the distant summits, which appeared to have escaped burial in this manner.
- Fig. 223 On the black lava sand at Marchena or Bindloe Island was discovered the signal of distress erected by shipwrecked mariners of the sloop *Dinamita*. Their desiccated bodies had been found ten days previously by Portuguese fishermen. Chart 99, p. 417.

PLATE 107

- Fig. 224 Tide pools at Darwin Bay, Tower Island, Galapagos. The mud flats at the right were inhabited by fiddler crabs, while frigate birds nested on the rocks to both right and left. The lava is fractured into rectangular blocks. (Photograph by W. L. Schmitt.) Chart 98, p. 416.
- Fig. 225 Marine collectors at work on a rocky beach at Darwin Bay, Tower Island, Galapagos. The headland marking the northern limit of the entrance to Darwin Bay is shown in the distance, and between it and the shore are two rocky reefs which prevent the ship's launch from coming farther inshore. (Photograph by W. L. Schmitt.)

PLATE 108

- Fig. 226 The landing place at Darwin Bay, Tower Island, consisting of an arching beach and a small lagoon behind which rise the basaltic walls of the rim of a volcanic crater.
- Fig. 227 The *Velero III* anchored in 27 fathoms in Darwin Bay, scarcely 150 yards from shore. The bay represents the cone of a mile-wide crater, a portion of which has weathered away, admitting the sea.

PLATE 109

- Fig. 228 Lava shores of Narborough Island, Galapagos, showing mangrove thickets in the distance. (Photograph by Wm. R. Taylor.) Chart 101, p. 418.
- Fig. 229 The island of Narborough, located across a narrow channel from Tagus Cove. It is shield volcano 4,000 feet high and without the irregularities of shape which characterize the other islands. Volcanic activity has been observed at Narborough as recently as 1927.

PLATE 110

- Fig. 230 Crater Lake, Albemarle Island, Galapagos. Tagus Cove may be seen to the left, at a considerably lower level. (Photograph by H. W. Manter.)

- Fig. 231 Two miles south of Tagus Cove, Albemarle Island, lies what is probably the largest crater lake in the archipelago. Although a mile or more in length, it does not appear on any chart and must be located anew by each expedition by means of directions handed down by preceding expeditions.

PLATE 111

- Fig. 232 Lava beach north of Tagus Cove, Galapagos. A grove of mangrove trees indicates a lagoon on the right. One of the five large volcanoes of Albemarle Island rises majestically in the distance.
- Fig. 233 Tagus Cove, Albemarle Island, the most protected anchorage in the islands, but unfortunately too small to hold many vessels at one time. Visiting ships have left their names whitewashed against the dark lava rocks. Tagus Cove is the home of the Galapagos penguin and the flightless cormorant. Chart 102, p. 418.

PLATE 112

- Fig. 234 The area around Christopher Point, Albemarle Island, is perhaps the most desolate in the entire Galapagos. Here many small spatter cones may be explored within a mile radius, provided one is fortunate in arriving in one of those rare periods in which a landing can be made. (Photograph by Wm. R. Taylor.)
- Fig. 235 One of the most massive single formations in the Galapagos archipelago is this perpendicular headland at Cape Berkeley, Albemarle Island. It is composed of volcanic ash and shows landslides resulting from the undercutting. A fairly safe anchorage for the tuna fleet is found close in at its base. (Photograph by H. W. Manter.)

PLATE 113

- Fig. 236 Members of the 1938 Hancock Expedition explore a huge crack in the misshapen mass of *pahoe hoe* lava at Cartago Bay, on the east side of Albemarle Island. Mangrove trees form an almost impenetrable barrier between the sand beach and the lava rock.
- Fig. 237 The *Velero III* anchored in Tagus Cove, Albemarle Island. The successive beds of volcanic ash of which the island is composed are nowhere seen better than along the south rim of the cove.

PLATE 114

- Fig. 238 Academy Bay, Indefatigable Island, showing houses in the middle distance which were occupied prior to 1938 by a Danish-American family named Rader. A garrison of Ecuadorian soldiers was stationed at the fort, which is known locally as Puerto Ayora. Chart 106, p. 420.
- Fig. 239 The large rock shingle at Barrington Island, Galapagos, was a profitable collecting ground for early Hancock Expeditions. The cactus-studded interior of the island is the home of land iguanas, hawks, and doves. Chart 106, p. 420. (Photograph by W. L. Schmitt.)

PLATE 115

- Fig. 240 Conway Bay, Indefatigable Island, showing stretches of coral sand separated by rocky promontories representing ancient lava flows. Such beaches are the homes of the ghost crab *Ocyropode*. Chart 107, p. 420.
- Fig. 241 Conway Bay, Indefatigable Island, Galapagos, showing Eden and Guy Faulkes islands in the distance. The reef in the foreground was a collecting station of the marine zoologists. Chart 107, p. 420.

PLATE 116

- Fig. 242 Interior of a crater at Daphne Major Island, Galapagos. The floor of the crater is of sand and is occupied by families of nesting blue-footed boobies.
- Fig. 243 Inlet at Academy Bay, Indefatigable Island, Galapagos, showing perpendicular lava cliffs and the two principal cactus types, *Opuntia* and *Pachycereus*. Chart 108, p. 421. (Photograph by Wm. R. Taylor.)

PLATE 117

- Fig. 244 South Seymour Island, which extends northward from Indefatigable Island, separated from it by a narrow channel. Its flora is similar to that of the parent island, dominant forms being the bursera tree and *Opuntia* cactus.
- Fig. 245 The veldt-like interior of South Seymour Island, Galapagos, showing bursera trees growing among lava boulders. (Photograph by C. McLean Fraser.)

PLATE 118

- Fig. 246 A view from South Seymour Island showing the many cones of Indefatigable Island. The beach in the foreground is marked with the tracks of the green sea turtle and the holes dug by the female turtle for egg-laying purposes. Chart 106, p. 420.
- Fig. 247 North Seymour Island showing land iguanas from South Seymour Island being landed in a transplantation experiment, there being no land iguanas previously on North Seymour. A nameless island, composed largely of sand, may be seen in the right background. It lies in the narrow channel separating North and South Seymour islands. Chart 106, p. 420.

PLATE 119

- Fig. 248 Agaves, or Century plants, line the red clay road which leads from Wreck Bay, Chatham Island, to Progreso, three miles to the interior. Here the plants appear to grow wild, but at higher elevations they form neat hedgerows separating the plantations. Chart 113, p. 423.
- Fig. 249 Village of Progreso, situated at an elevation of over 1,000 feet in the interior of Chatham Island, Galapagos. The houses are built of cane imported from the mainland, and many of them are elevated from the ground in the manner of houses of the Santa Elena Peninsula. The population of Progreso is said to be around 300. Chart 113, p. 423.

PLATE 120

- Fig. 250 The few buildings located at Wreck Bay, Chatham Island, consist of headquarters for the governor and his military aides, and a lighthouse. They are built of bamboo, or "Guayaquil cane," the same type of construction found in the maritime provinces of Ecuador. Chart 113, p. 423.
- Fig. 251 Wreck Bay, Chatham Island, the principal port of the Galapagos and home of the military governor. A treacherous reef at the harbor entrance obliges vessels the size of *Velero III* to anchor outside, while small sailing vessels may anchor near the wharf.

PLATE 121

- Fig. 252 Post Office Bay, Charles Island, a favorite collecting ground for *Velero III* scientists. Within a short radius may be found sandy beach, rocky shore, brackish lagoon, and a sizable cave in which were trapped many of the now extinct Charles Island tortoise. Chart 111, p. 422.
- Fig. 253 Captain Allan Hancock standing beside the barrel post office at Post Office Bay, Charles Island, perhaps the best-known single feature in the Galapagos Islands. This old barrel, or one like it, has been in continuous use since the days of Gloucester whalers, 150 years or more ago.

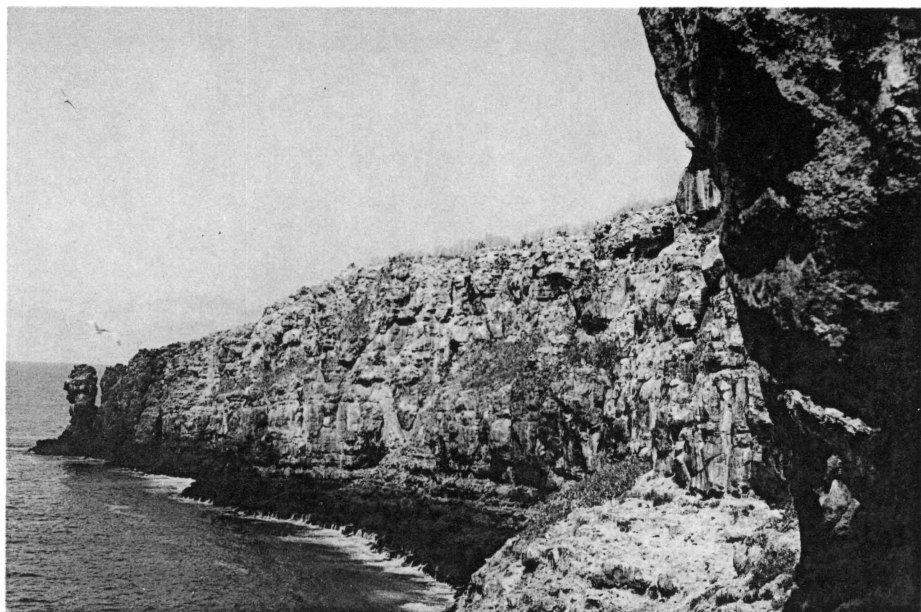


Fig. 220 Wenman Island, Galapagos, landing

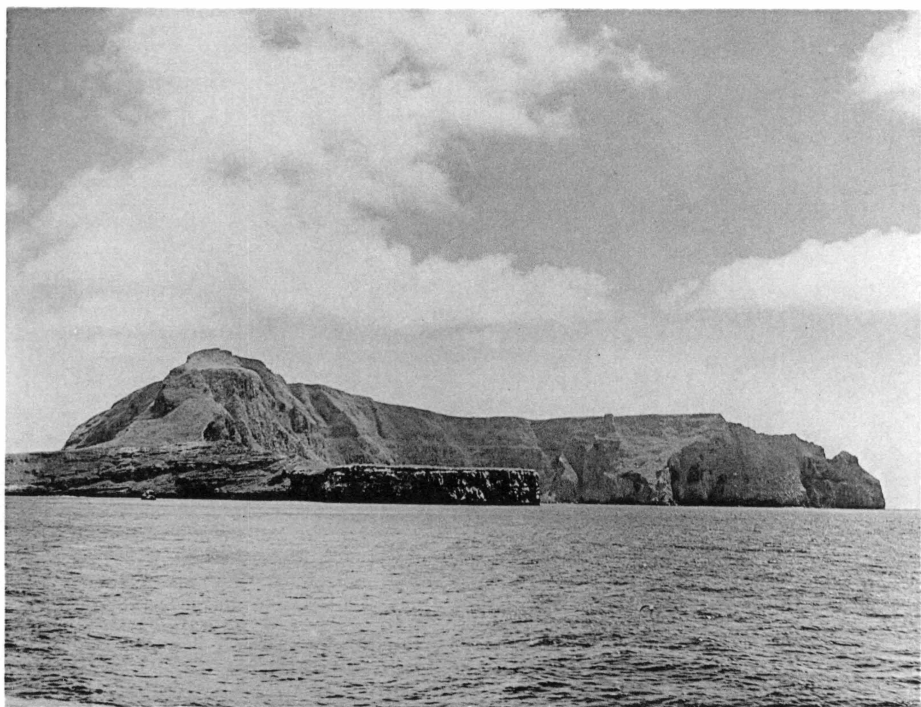


Fig. 221 Wenman Island, Galapagos



Fig. 222 Marchena Island, Galapagos

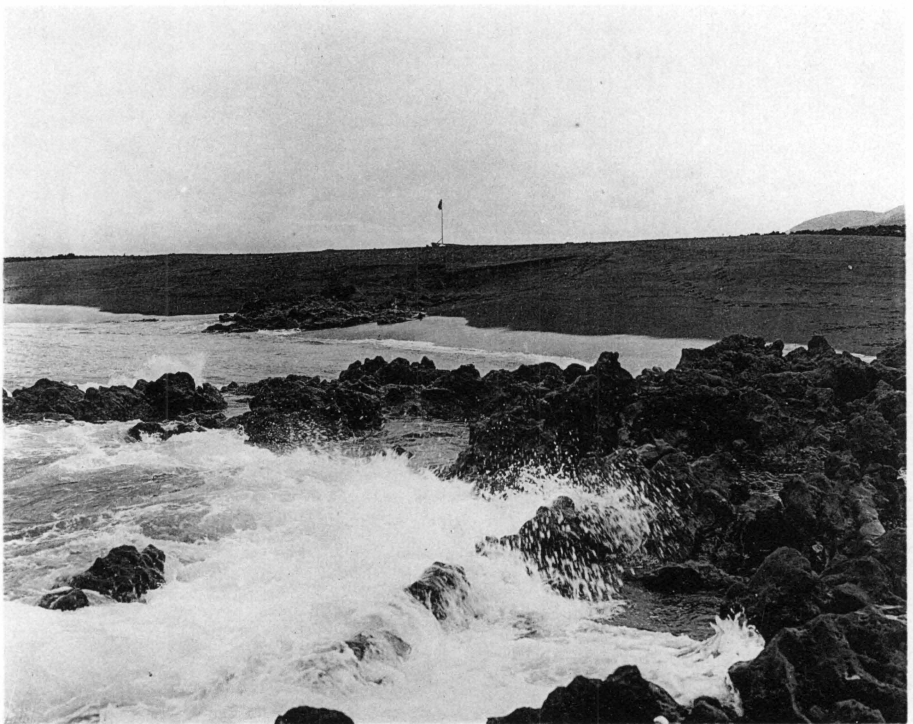


Fig. 223 Marchena Island, Galapagos



Fig. 224 Darwin Bay, Tower Island, Galapagos



Fig. 225 Darwin Bay, Tower Island, Galapagos

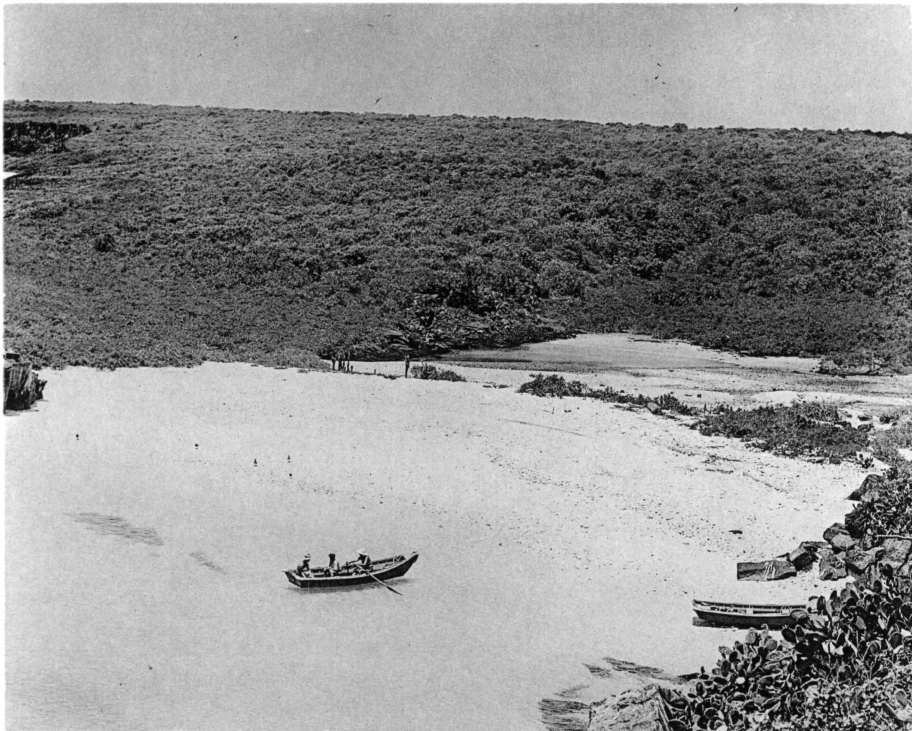


Fig. 226 Darwin Bay, Tower Island, landing place, Galapagos

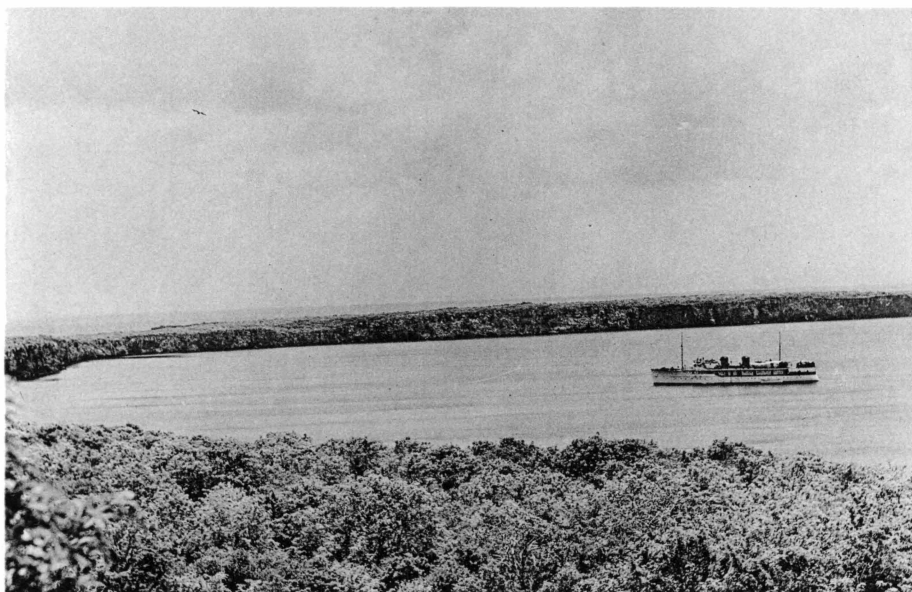


Fig. 227 Darwin Bay, Tower Island, Galapagos



Fig. 228 Narborough Island, Galapagos, near Mangrove Point



Fig. 229 Narborough Island, Galapagos, seen from Tagus Cove



Fig. 230 Tagus Cove and Crater Lake, Albemarle Island



Fig. 231 Panorama of Crater Lake south of Tagus Cove, Albemarle Island



Fig. 232 Beach north of Tagus Cove, Albemarle Island



Fig. 233 Tagus Cove, Albemarle Island

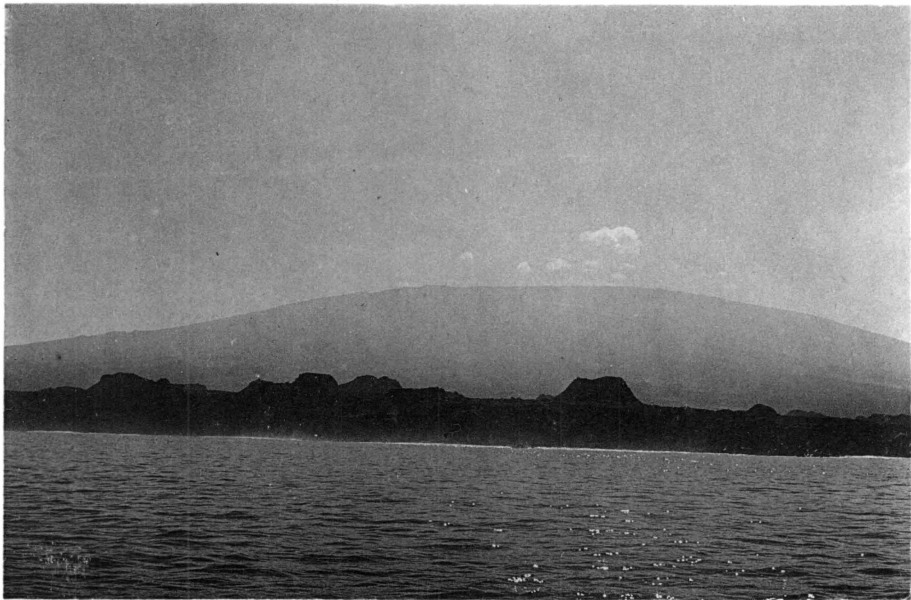


Fig. 234 Cristofer Point, Albemarle Island



Fig. 235 Cape Berkeley, Albemarle Island



Fig. 236 Cartago Bay, Albemarle

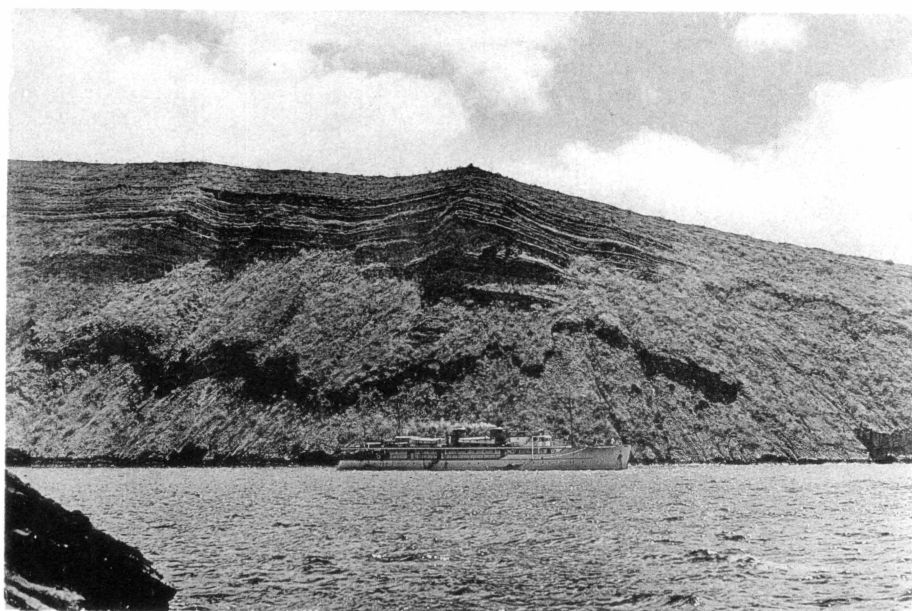


Fig. 237 Tagus Cove, Albemarle

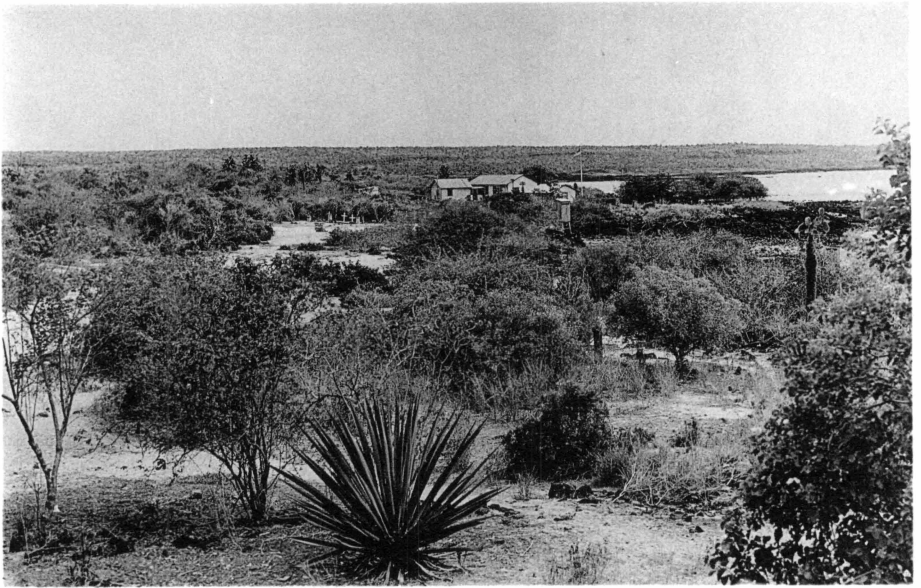


Fig. 238 Academy Bay, Indefatigable Island



Fig. 239 Barrington Island, Galapagos



Fig. 240 Conway Bay, Indefatigable Island

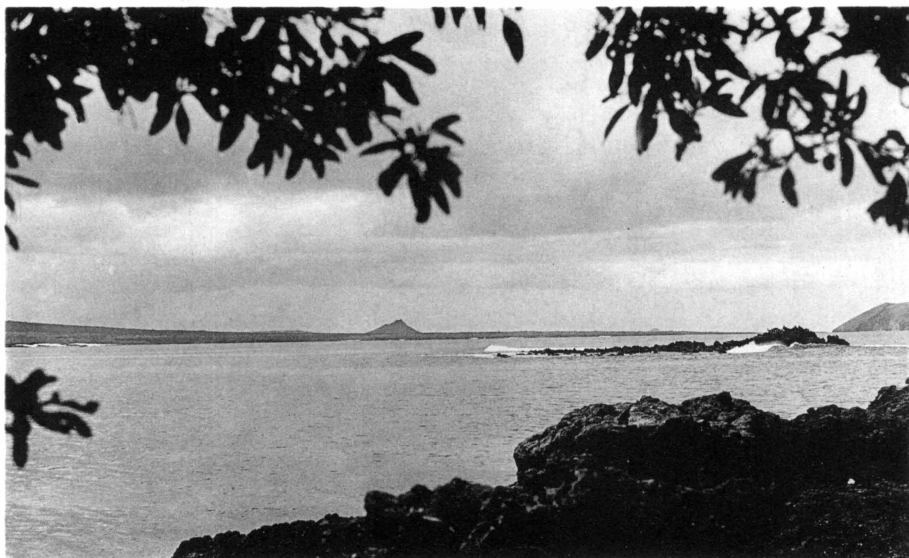


Fig. 241 Reef in Conway Bay, Indefatigable Island

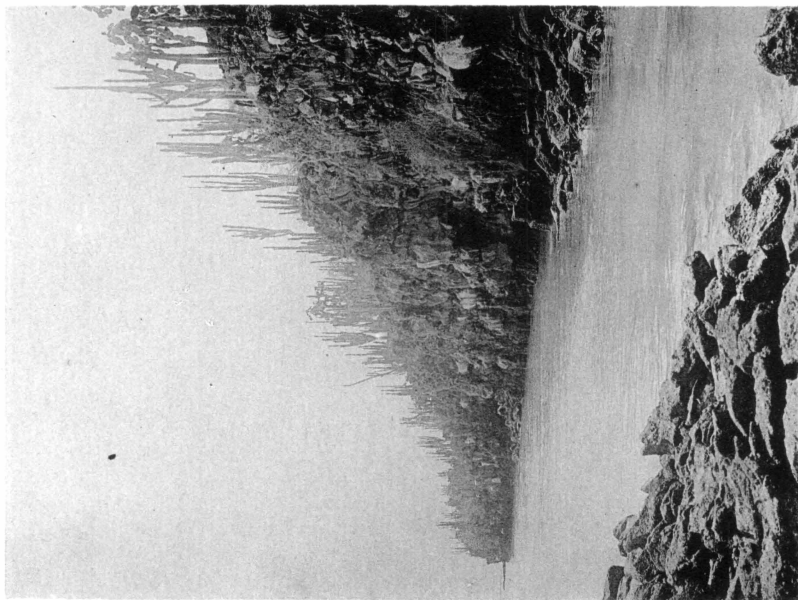


Fig. 243 Academy Bay, Indefatigable Island

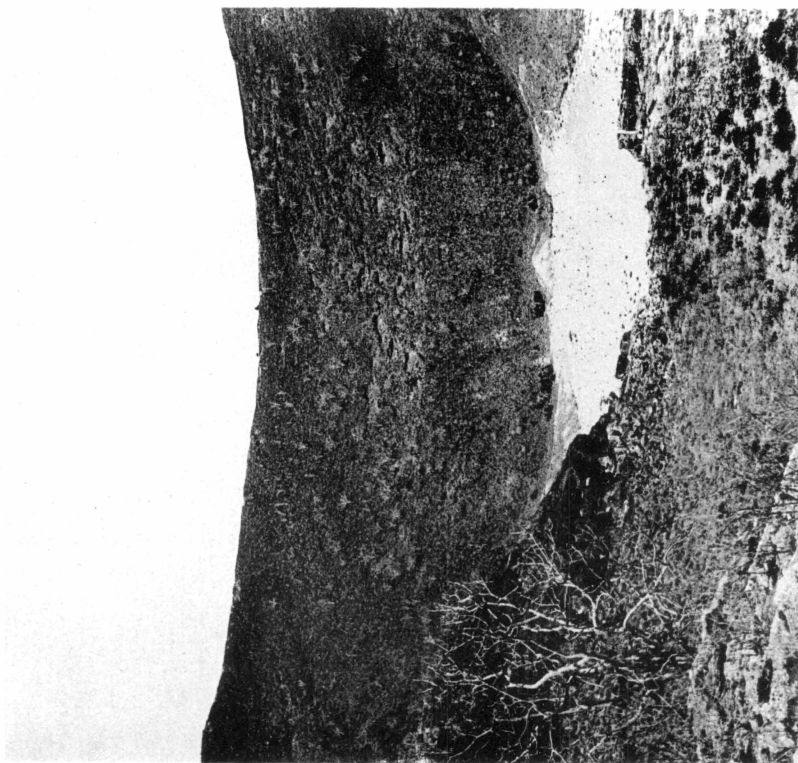


Fig. 242 Daphne Major Island, Galapagos

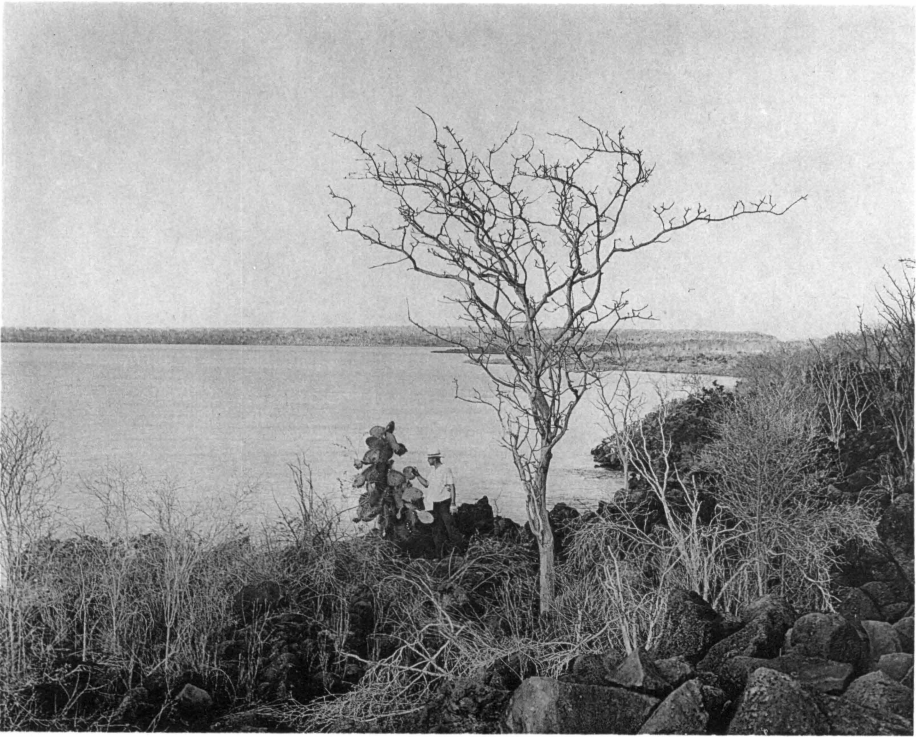


Fig. 244 South Seymour Island from Indefatigable

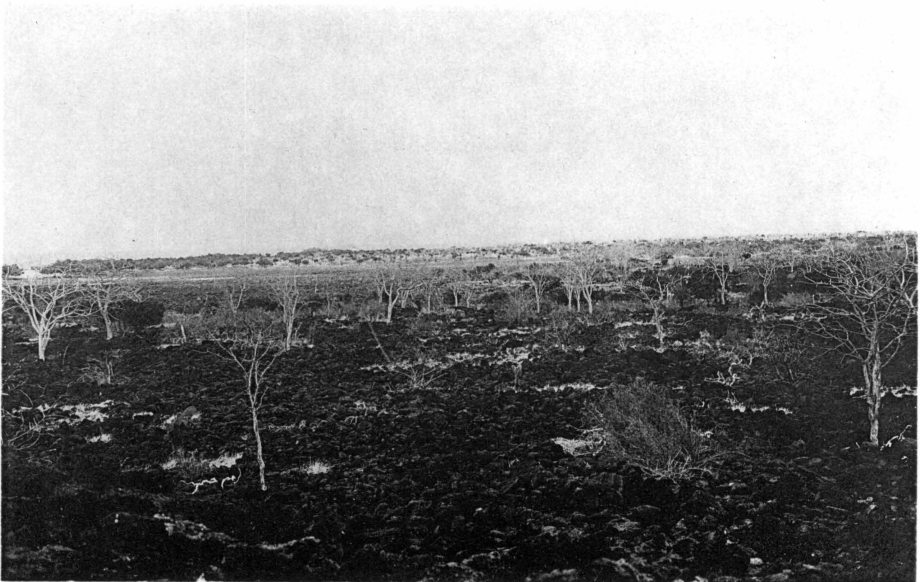


Fig. 245 South Seymour Island



Fig. 246 South Seymour Island looking toward Indefatigable



Fig. 247 North Seymour Island



Fig. 248 Chatham Island



Fig. 249 Chatham Island, village of Progreso

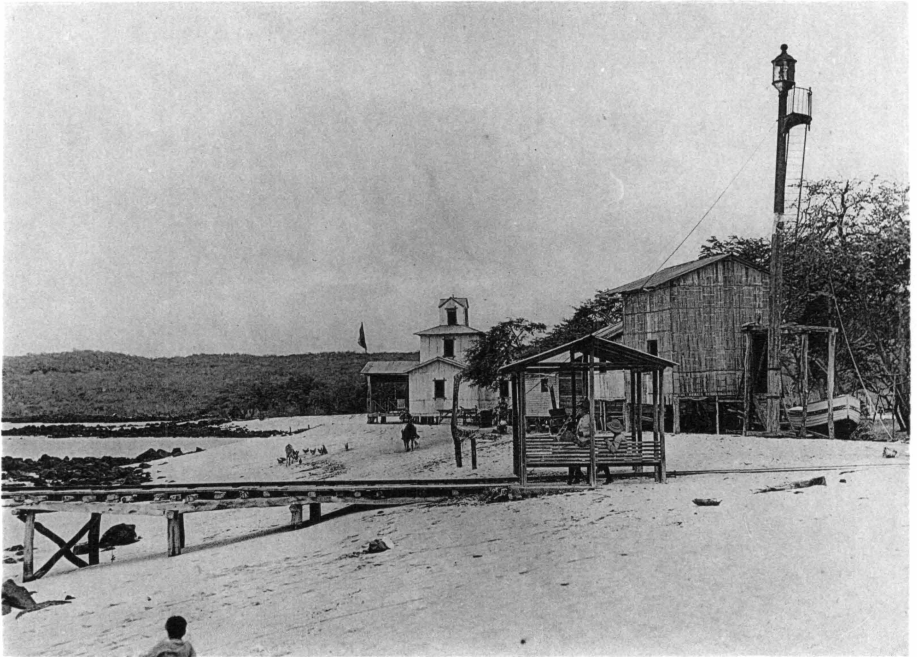


Fig. 250 Chatham Island, Wreck Bay Lighthouse

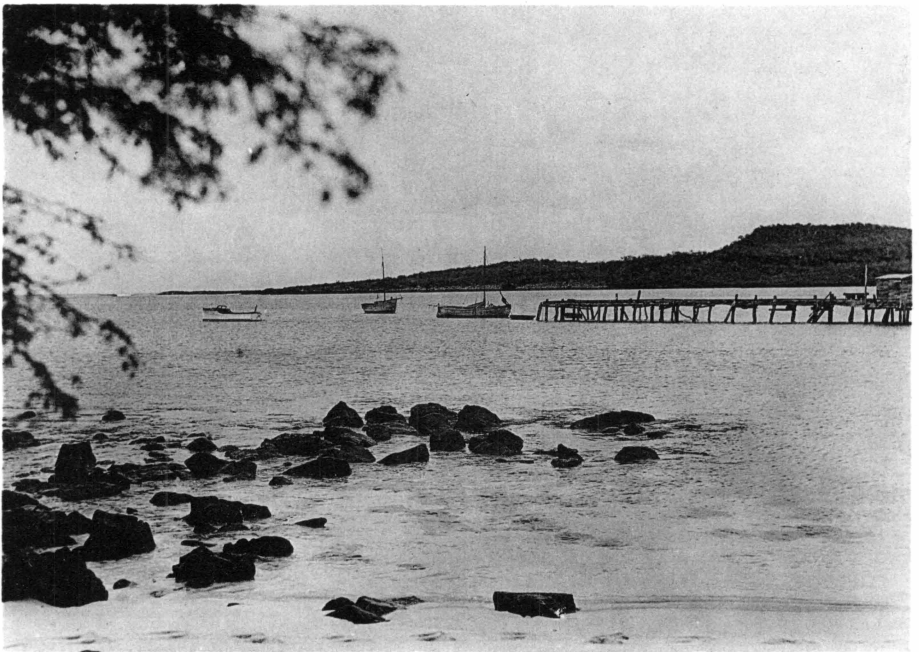


Fig. 251 Chatham Island, Wreck Bay



Fig. 252 Post Office Bay, Charles Island

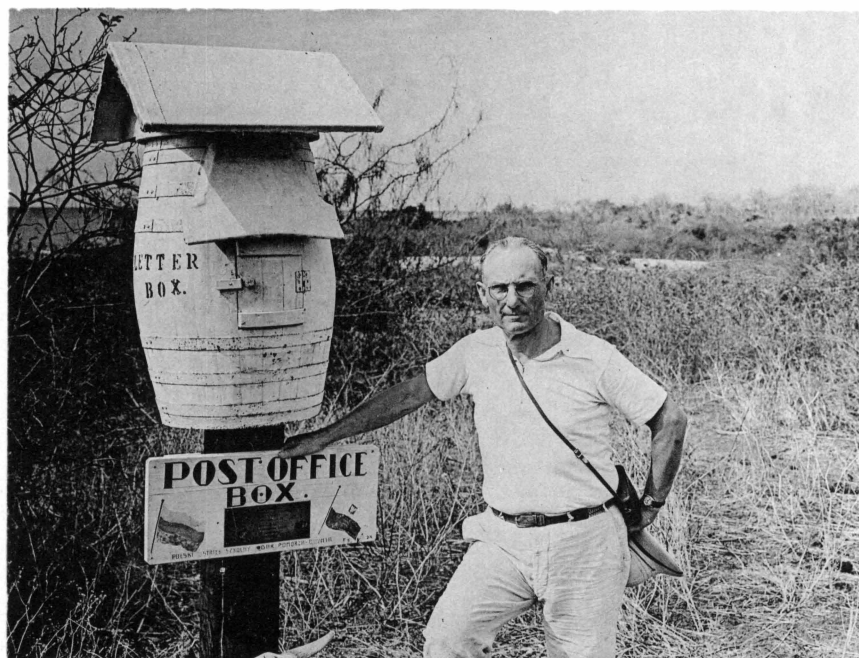
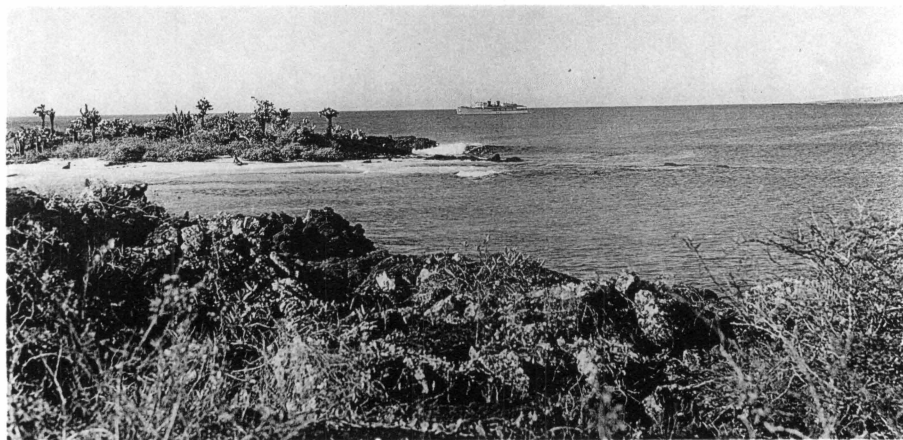
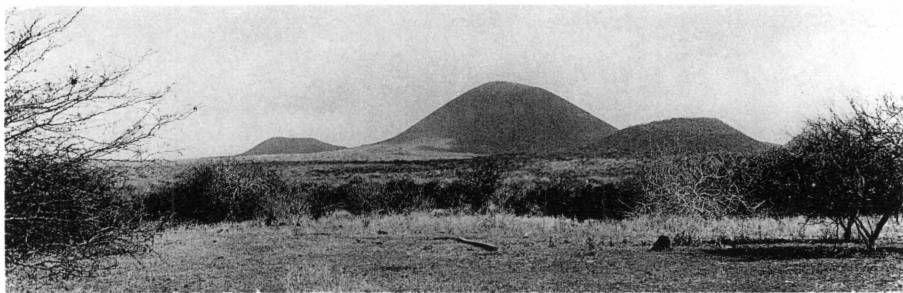


Fig. 253 Captain Hancock at barrel post office



Figs. 254-256 Charles Island, vicinity of Black Beach

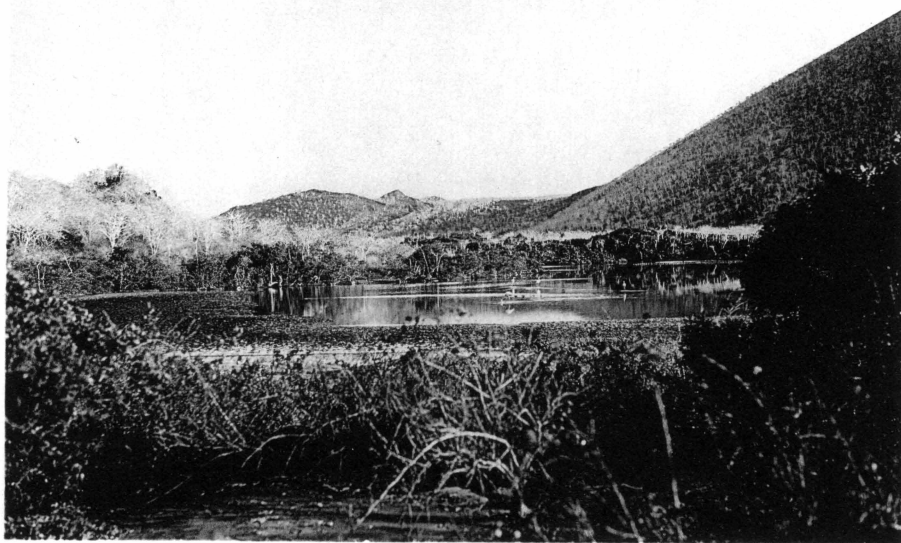


Fig. 257 Charles Island, lagoon, Post Office Bay



Fig. 258 Hood Island, Galapagos

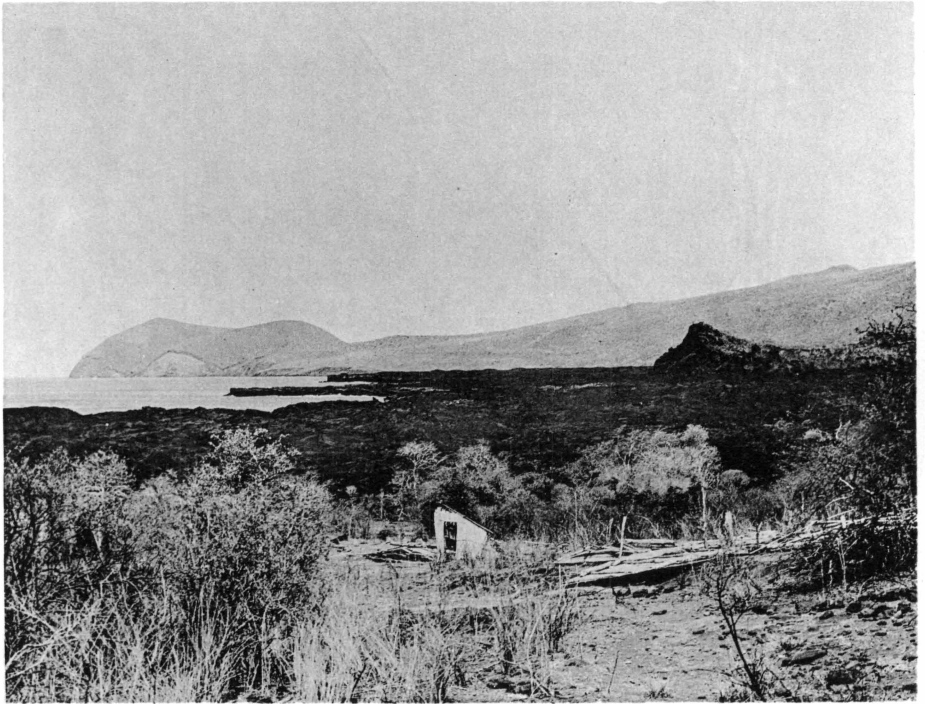


Fig. 259 James Bay, James Island, looking north



Fig. 260 James Bay, James Island



Fig. 261 Interior of James Island

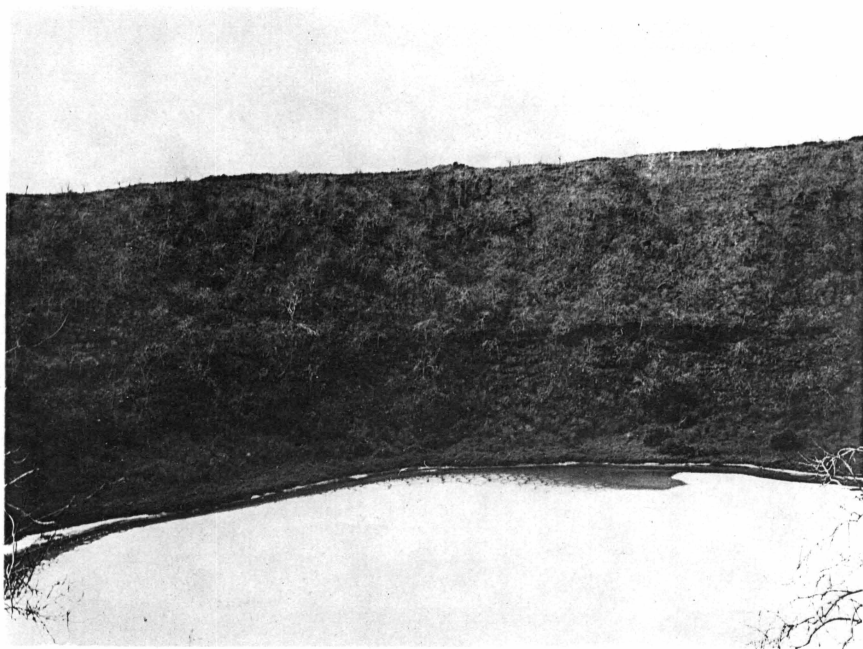


Fig. 262 Crater lake of James Island

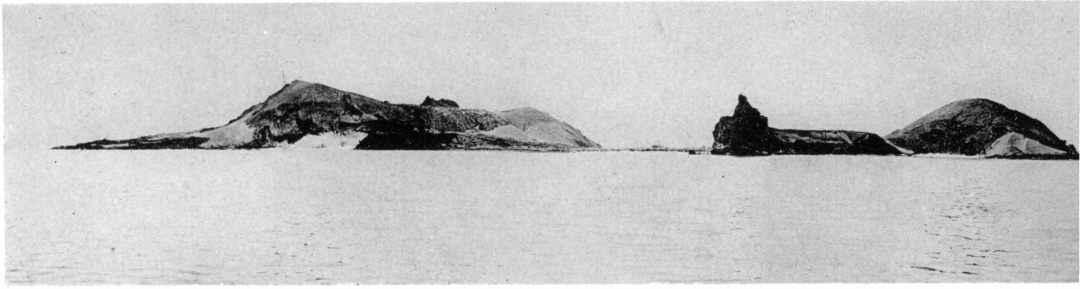


Fig. 263 Panorama, Sullivan Bay, James Island

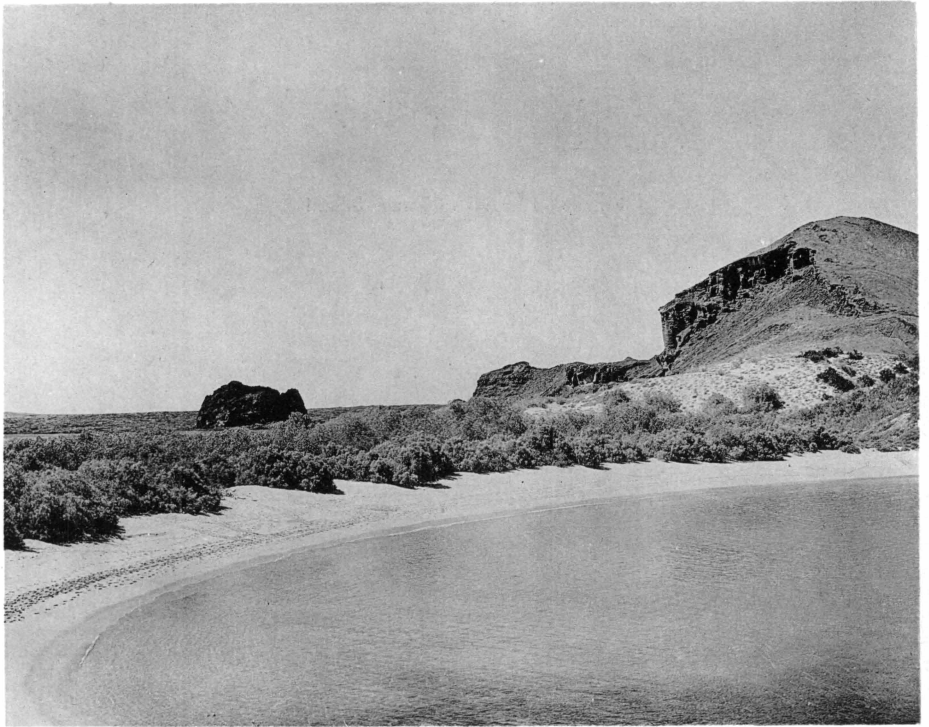


Fig. 264 Landing, Sullivan Bay, James Island

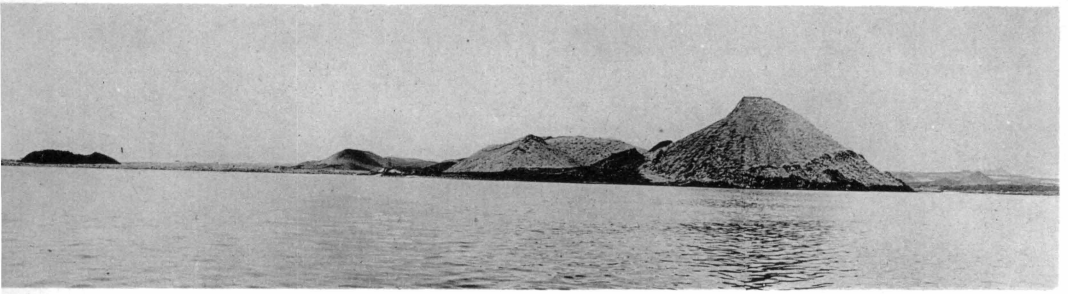


Fig. 265 Sea stack, Sullivan Bay, James Island



Fig. 266 James Island, Galapagos seen from Bartholomew Island



Fig. 267 Spatter cones, Bartholomew Island

PLATE 122

- Fig. 254 Craters of Charles Island, Galapagos, top the gentle rise from Black Beach Anchorage, on the east side of the island. A three-mile trail led to Friedo, home of Dr. Ritter, and a seven-mile trail to Paradise, home of the Baroness Wagner-Bosquet.
- Fig. 255 Black Beach, Charles Island, anchorage most frequented by *Velero III* in the Galapagos Islands. Shore collecting was accomplished on the rocky beaches in the foreground, and Black Beach served as a starting point for numerous treks to the interior. Chart 110, p. 422.
- Fig. 256 The highlands of Charles Island, Galapagos, above an elevation of 1,000 feet, are covered with brush tangles formed by bursera trees and other vegetation, including citrus groves planted by early settlers, which have now gone wild. Such rank vegetation is found only in the belt of fog, or "garua" as it is locally known. (Photograph by W. L. Schmitt.)

PLATE 123

- Fig. 257 Lagoon at Post Office Bay, Charles Island, Galapagos, showing flamingos which feed upon a pink alga which grows beneath the surface. Fiddler crabs occur around the margins of the lagoon. The shadowy forms on the distant hills are bursera trees. (Photograph by W. L. Schmitt.)
- Fig. 258 View of the east coast of Hood Island, Galapagos, looking north toward Osborn Island and Gardner Bay. An albatross rookery occupies the level portion of the promontory in the middle distance during a portion of the year. Chart 114, p. 424.

PLATE 124

- Fig. 259 View looking across James Bay, James Island, from the abandoned habitations located at the south side of the Bay. An apparently fresh lava flow is seen in the middle distance. A trail leads off to the right to a crater lake mentioned by Darwin. Chart 103, p. 419.
- Fig. 260 The headland which marks the northern limit of James Bay, James Island, Galapagos, has been cut by wave action, the perpendicular cliff exposing a cross section of the lava cap which covers this portion of the island. The Expedition launch is shown in the foreground. (Photograph by W. L. Schmitt.)

PLATE 125

- Fig. 261 The interior of James Island contains some of the tallest trees which are to be found in the archipelago, although those of southern Albarmarle in the region of Villamiel are said to be larger. An Expedition member stands on the trail leading from the beach to the crater lake. (Photograph by W. L. Schmitt.)
- Fig. 262 The crater lake at James Bay, James Island, was visited by Darwin over 100 years ago. It has been a source of salt to visitors to the Galapagos Islands for an even longer period. The bottom of the crater was reached by a cable car, cable and windlass now lying rusted and useless. (Photograph by W. L. Schmitt.)

PLATES 126, 127

- Fig. 263 Panorama of Sullivan Bay, Galapagos, showing, from left to right, summit, landing place, and sea stack of Bartholomew Island; landing place, lava flows, and craters of James Island. In taking the picture the camera described an arc of almost 180 degrees, or from southeast of the anchorage to almost northwest. (Photograph by Dr. Waldo L. Schmitt.)

- Fig. 264 Curving strand opposite the constriction cut by Sullivan Bay, James Island, into Bartholomew Island, which forms its southern boundary. The channel separating Bartholomew and James islands passes between the lava cone in the right background and the dark promontory in the left center and may be seen above the row of mangrove trees. Chart 105, p. 419.
- Fig. 265 The sea stack at Sullivan Bay, James Island, one of the most conspicuous landmarks in the entire Galapagos group. It is located on Bartholomew Island, which forms the southern shore of the bay. A narrow channel separates Bartholomew Island from James Island itself. Chart 105, p. 419.

PLATE 128

- Fig. 266 View of James Island, Galapagos, from the summit of Bartholomew Island. Sullivan Bay is shown at the right, dominated by a lava stack and a comparatively recent lava flow. The small arm of the sea which cuts off Bartholomew Island from James Island may be seen just beyond the promontory to the left. (Photograph by Wm. R. Taylor.)
- Fig. 267 View of James Island from Bartholomew Island showing numerous small spatter cones with which the smaller island is studded. Chart 105, p. 419. (Photograph by Wm. R. Taylor.)





