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R. S. PATTON, *Director*

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UNITED STATES COAST PILOT

THE HAWAIIAN ISLANDS

SECOND EDITION

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NOTE

The courses and bearings given in degrees are *true*, reading clockwise from 0° at north to 359°, and are followed by the corresponding *magnetic course* in points, in parentheses. General directions, such as northeastward, west-southwestward, etc., are magnetic.

Distances are in *nautical miles* and may be converted approximately to statute miles by adding 15 percent to the distances given.

Currents are expressed in knots, which are nautical miles per hour.

Except where otherwise stated, all depths are at *mean lower low water*.

In accordance with the desire of the International Hydrographic Bureau, each depth is followed, in parentheses, by its equivalent in meters.

Heights are given in feet with metric equivalent in parentheses.

Changes and other corrections affecting all Coast Pilot volumes are included in the Notice to Mariners published weekly by the U.S. Department of Commerce. About one year after a Coast Pilot is published, and at approximately yearly intervals thereafter until a new edition is brought out, a supplement, giving the more important corrections and additions to its text since the date of its publication, is issued. The date of the latest supplement to each Coast Pilot, for which a supplement has been issued, is shown in the list of Coast Pilots published each week in the Notice to Mariners. Any supplement may be obtained, free of charge, upon application to the Coast and Geodetic Survey, Washington, D.C., or any of its field stations. Each supplement is complete in itself and cancels all previous supplements.

Do not use this Coast Pilot except with reference to the latest supplement that may have been published and Notices to Mariners issued after the date of the supplement.

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INTRODUCTION

DEPARTMENT OF COMMERCE,
U.S. COAST AND GEODETIC SURVEY,
Washington, January 10, 1933.

This publication contains information relating to the Hawaiian Islands and includes the islands and reefs extending westward to Midway and Kure Islands.

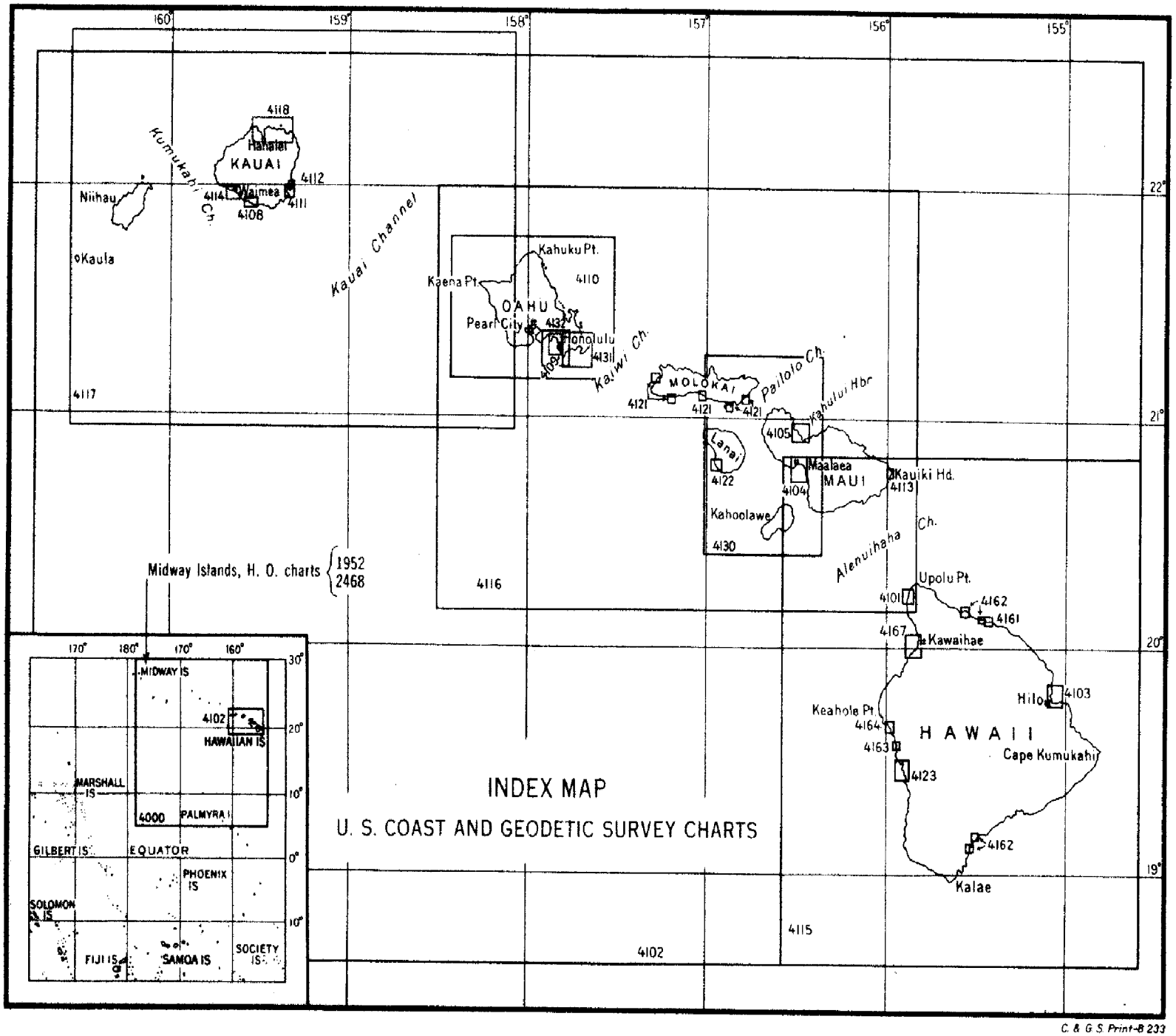
This edition, which is the second of the series, was prepared by Lieut. Charles K. Green, U.S. Coast and Geodetic Survey. The compilation was supervised by Lieut. Commander R. R. Lukens, Chief Coast Pilot Section.

Great courtesy has been shown by the Lighthouse Service, United States Engineers, and masters of vessels navigating Hawaiian waters, in furnishing information for use in this publication.

The aids to navigation are corrected to January 10, 1933.

Navigators are requested to notify the Director of the Coast and Geodetic Survey of any errors or omissions they may find in this publication or any additional matter which they think should be inserted for the information of mariners.

R. S. PATTON, *Director.*



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UNITED STATES COAST PILOT

HAWAIIAN ISLANDS, INCLUDING THE ISLANDS, ROCKS, AND SHOALS WESTWARD

GENERAL INFORMATION

This volume contains information regarding the islands of Hawaii, Maui, Kahoolawe, Lanai, Molokai, Oahu, Kauai, Niihau, and the adjacent small islands, and includes the islands and reefs extending in a west-northwesterly direction to Midway and Ocean Islands.

The Hawaiian Islands are situated near the northern limits of the Tropics, the larger ones lying between 18°55′ and 22°15′ north latitude, and between 154°50′ and 160°30′ west longitude. The islands are mountainous and of volcanic origin, and it is said that their formation occurred at various periods, those at the westerly end of the group being the oldest and those at the easterly the youngest. This difference in the age of the islands accounts for the difference in appearance as viewed from offshore. Hawaii, the youngest island of the group, shows very little evidence, comparatively speaking, of erosion, while Kauai, the oldest of the larger islands, is considerably cut up by gorges and ravines. On almost all of the islands the northeasterly slopes are the most irregular, as the rainfall generally is the greatest on this side, resulting in torrents that cut ravines in the slopes of the islands.

The 20-fathom (37 m) curve rarely extends over 1 mile from shore and usually is only a short distance beyond the coral reef which in some places fringes the coast line of the islands. There are few off-lying dangers, and usually these are indicated by breakers or by a change in the color of the water.

The Hawaiian Islands were first made known to the world by Capt. James Cook, R.N., who sighted them on January 18, 1778. He named them the Sandwich Islands. They became an integral part of the United States of America by annexation on August 12, 1898, and on June 14, 1900, were constituted as the Territory of Hawaii.

Distance table.—The distance table shown on page 2 is a reprint from Distances Between United States Ports published by the Coast and Geodetic Survey, price 10 cents. The distances are given in nautical miles for the shortest navigable route.

Distances between ports of the Hawaiian Islands

From—↓ To—→	Hilo	Honuapo	Kealakekua Bay	Kailua	Mahukona	Hana Bay	Lahaina	Kahului Harbor	Kaumalapau	Kamalo Harbor	Kaunakakai	Kolo Harbor	Honolulu	Hanamaulu Bay	Nawiliwili Bay	Port Allen	Waimea Bay	Hanalei Bay
Hawaii Island																		
Hilo		81	118	109	71	84	122	117	136	137	145	153	194	284	284	294	300	304
Honuapo	81		61	70	105	139	152	173	155	167	174	175	208	295	293	301	307	316
Kealakekua Bay	118	61		11	47	81	95	115	100	110	118	120	156	245	244	253	259	265
Kailua	109	70	11		38	72	86	106	91	101	109	111	147	236	235	244	250	256
Mahukona	71	105	47	38		36	62	70	76	77	85	93	133	222	222	232	238	242
Maui Island																		
Hana Bay	84	139	81	72	36		57	35	71	59	69	77	118	210	210	220	226	224
Lahaina	122	152	95	86	62	57		27	25	16	24	32	74	166	166	176	182	186
Kahului Harbor	117	173	115	106	70	35	27		47	29	39	47	88	180	180	190	196	194
Lanai Island																		
Kaumalapau	136	155	100	91	76	71	25	47		24	21	22	60	151	151	161	167	171
Molokai Island																		
Kamalo Harbor	137	167	110	101	77	59	16	29	24		12	20	61	153	153	163	169	173
Kaunakakai	145	174	118	109	85	69	24	39	21	12		10	52	144	144	154	160	164
Kolo Harbor	153	175	120	111	93	77	32	47	22	20	10		43	135	135	145	151	155
Oahu Island																		
Honolulu	194	208	156	147	133	118	74	88	60	61	52	43		96	96	106	112	116
Kauai Island																		
Hanamaulu Bay	284	295	245	236	222	210	166	180	151	153	144	135	96		5	23	29	27
Nawiliwili Bay	284	293	244	235	222	210	166	180	151	153	144	135	96	5		20	26	32
Port Allen (Eleele)	294	301	253	244	232	220	176	190	161	163	154	145	106	23	20		8	41
Waimea Bay	300	307	259	250	238	226	182	196	167	169	160	151	112	29	26	8		35
Hanalei Bay	304	316	265	256	242	224	186	194	171	173	164	155	116	27	32	41	35	

Honolulu to—	*Miles*
Seattle, Wash	2,409
San Francisco	2,091
Los Angeles Harbor	2,228
San Diego, Calif	2,278

9

Area.—The total land area of the Hawaiian group is approximately 6,450 square miles, of which the island of Hawaii comprises 62 percent.

Rivers.—There are numerous streams, nearly all of which may be classed as mountain torrents, although small boats can navigate a few of them for short distances. The streams are usually found on the north and east coasts.

Population.—By the census of 1930 the islands had a population of 368,336.

Products.—Agriculture is the principal occupation of the inhabitants. The principal products are sugar, pineapples, coffee, and cattle. Rice, cotton, tropical fruits, and vegetables are also cultivated. Sheep and hogs are raised to some extent.

Trade.—The principal trade is with the United States. The port of entry is Honolulu. The subports are Hilo and Mahukona, Hawaii; Kahului, Lahaina and Hana, Maui; Nawiliwili, Ahukini, and Port Allen, Kauai. During the year 1930 there were nearly 11,000,000 tons of arrivals and departures through the ports of the islands.

Standard time.—The standard time of the Hawaiian islands is 157°30′ west longitude time.

Government.—The Territory of Hawaii has a Governor who is appointed by the President of the United States for a period of four years, and a legislative assembly at Honolulu. The Territory is represented in Congress at Washington by a delegate elected biennially. Many of the Government bureaus have offices at Honolulu, including the Coast and Geodetic Survey, U.S. Engineers, Navigation and Steamboat Inspection Service, Lighthouse Service, Hydrographic Office, Geological Survey, and Public Health Service.

Lighthouse Service.—The waters covered by this volume are under the jurisdiction of the nineteenth lighthouse district, and all reports or communications regarding lights or aids to navigation should be addressed to Superintendent of Lighthouses, room 201 Federal Building, Honolulu, Hawaii.

Bureau of Navigation and Steamboat Inspection.—The waters of Hawaii come under the jurisdiction of the first district, with local inspectors in the Federal Building, Honolulu.

Marine hospital.—Information as to relief furnished seamen will be found in the regulations of the U.S. Public Health Service, which can be consulted at the station of the service located in the Federal Building, Honolulu. This is a class II relief station and has contract hospital space. The nearest marine hospital to the Hawaiian Islands is located at San Francisco, Calif.

Quarantine.—National quarantine laws are enforced in the islands by officers of the U.S. Public Health Service. Quarantine officials are located at the ports of Honolulu, Hilo, Mahukona, Kahului, Lahaina, Nawiliwili, Ahukini, and Port Allen. Information regarding quarantine regulations may be had at the offices of the service in the Federal Building, Honolulu.

Plant and animal quarantines.—The regulations of the U.S. Department of Agriculture prohibit the importation into United States waters of certain fruits, vegetables, and plants from the Territory of Hawaii. Other fruits and vegetables may be imported from the Territory only when accompanied by certificates of inspection.

Regulations of the Territorial Board of Commissioners of Agriculture and Forestry prohibit the importation into Hawaiian waters of certain fruits and vegetables unless accompanied by certificates of inspection. Dogs and cats imported into the Territory coming through any country, State, or Territory not officially declared free from rabies are kept in quarantine from 90 to 180 days at the expense of the owner. They may be imported only through the port of Honolulu. Dogs and cats belonging to vessels must be securely confined on board while in Hawaiian waters.

These regulations are for the purpose of reducing the spread of plant and animal diseases. They apply to small as well as large quantities, and must be strictly complied with.

Chart agencies.—Charts and publications of the Coast and Geodetic Survey and of the Hydrographic Office are kept for sale at the Honolulu Paper Co., Ltd., 1045 Bishop Street, Honolulu. These publications may be inspected free of charge at the offices of the above Federal services.

Pilotage is compulsory for certain vessels. There are pilots at the principal ports who come off in small boats to vessels making signal outside the entrance. Pilotage fees and extracts from the Rules and Regulations of the Board of Harbor Commissioners of the Territory of Hawaii will be found in the appendix.

Rules of the Road.—International Rules to prevent collisions of vessels, are published in the appendix.

Navigation laws of the United States are published by the Bureau of Navigation, Department of Commerce, at intervals of four years, the present edition being that of 1931. The volume can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C.; price, $1.

System of buoyage.—In conformity with section 4678 of the Revised Statutes of the United States, the following order is observed in coloring and numbering buoys in United States waters, viz:

In approaching the channel, etc., from seaward, red buoys with even numbers, will be found on the starboard side.

In approaching the channel, etc., from seaward, black buoys with odd numbers, will be found on the port side.

Buoys painted with red and black horizontal stripes will be found on obstructions, with channel ways on either side of them, and may be left on either hand in passing in.

Buoys painted with white and black perpendicular stripes will be found in mid-channel, and must be passed close-to to avoid danger.

All other distinguishing marks to buoys will be in addition to the foregoing and may be employed to mark particular spots.

Perches with balls, cages, etc., will, when placed on buoys, be at turning points, the color and number indicating on what side they shall be passed.

Nun buoys, properly colored and numbered, are usually placed on the starboard side, and can buoys on the port side of channels.

Day beacons (except such as are on the sides of channels, which will be colored like buoys) are constructed and distinguished with special reference to each locality, and particularly in regard to the background upon which they are projected.

Aids to navigation.—The lighthouses and other aids to navigation are the principal guides and mark the approach and channels to the important ports. The buoyage accords with the system adopted in United States waters. Hawaiian aids are described in Light Lists, Pacific Coast, published by the Lighthouse Service and sold by the Superintendent of Documents; price 50 cents.

Special signals for surveying vessels of the U.S. Coast and Geodetic Survey employed in hydrographic surveying have been prescribed as follows:

By day, a surveying vessel under way and employed in hydrographic surveying, may carry in a vertical line, one over the other, not less than 6 feet apart where they can best be seen, three shapes not less than 2 feet in diameter of which the highest and lowest shall be globular in shape and green in color and the middle one diamond in shape and white.

By night, a surveying vessel under way and employed in hydrographic surveying, shall carry the regular lights prescribed by the Rules of the Road.

When at anchor in a fairway and engaged on surveying operations, a survey vessel shall display during the daytime two black balls in a vertical line and 6 feet apart. At night two red lights shall be displayed in the same manner. In the case of a small vessel the distance between the balls and between the lights may be reduced to 3 feet if necessary.

Such vessels, when at anchor in a fairway on surveying operations, shall have at hand and show if necessary in order to attract attention a flare-up light in addition to the lights which are, by this regulation, required to be carried.

Anchorages are numerous, except on the northerly and easterly sides of the islands, the first requirement under ordinary conditions being shelter from the trade winds. During kona weather most of the anchorages on the southerly and westerly sides of the islands are unsafe.

Harbors and ports.—The only harbors which offer protection in all weather are Honolulu, Hilo, Kahului, and Nawiliwili on the islands of Oahu, Hawaii, Maui, and Kauai, respectively. There are numerous other ports and landings with protection from certain directions only.

Harbor control.—A harbor master is appointed for each of the harbors of Honolulu, Hilo, and Kahului, and they have charge of the anchorage and berthing of vessels in their respective harbors. For harbor regulations see Appendix. There are local officials who are charged with the duties of harbor masters at various other ports.

Towboats.—Young Bros. and the Matson Navigation Co. each operate seagoing towboats out of Honolulu. Small gasoline towboats are available at the following ports: Hilo, Kahului, Ahukini, and Nawiliwili.

Supplies.—Provisions, ice, lumber, and ship-chandler's stores can be obtained at Honolulu, Hilo, and Kahului. Supplies in limited amounts can be obtained at many other ports and landings.

Water can be conveniently obtained at the wharves at Honolulu, Hilo, Kahului, Nawiliwili, and Ahukini. Water may also be obtained at other ports and landings.

Coal, fuel oil, and lubricating oils can be obtained at Honolulu, Hilo, and Kahului. Gasoline may be had at most of the landings.

Repairs.—There are machine shops at Honolulu, Hilo, and Kahului, and ordinary repairs to machinery can be made. The railroad and plantation shops on Kauai can handle some emergency repairs. There are three floating drydocks at Honolulu having keel-block lengths of 352 feet, 165 feet, and 53 feet. The large dock has a dead-weight capacity of 4,500 tons and has lifted vessels over 400 feet long.

Wharves and lighters.—Wharves at which vessels can lie to discharge and load are located at Honolulu, Hilo, Kahului, Ahukini, Nawiliwili, Lahaina (Mala), Hana, and Kaunakakai; the last three

are for smaller vessels only. At the other ports freight is handled either by lighters or wire cable.

Railroads.—A railroad skirts the shores of Oahu westward from Honolulu along the southwesterly and northwesterly sides and halfway down the northeasterly side. Another extends northwestward from Honolulu about one half the way across the island. Railroads extend northwestward, southward, and southeastward from Hilo. Railroads also extend a short distance northeastward, southward, and northwestward from Kahului. There are other short railroad lines at various places, practically all of which are for plantation use only.

Highways.—There are good highways in many parts of the islands, and automobiles can be obtained at most of the towns.

Communication with San Francisco, Vancouver, Auckland, Sydney, Manila, Yokohama, and Hong Kong may be had by several regular lines of steamers which touch at Honolulu. There is also a line of steamers to Seattle and Tacoma and another to the east coast of the United States via the Panama Canal. An excellent interisland service of both steamers and airplanes is maintained.

Cable and telephone.—There is communication by cable to San Francisco and to Manila via Midway and Guam, and by radiotelegraph between the islands and with the mainland of the United States and with the Orient. There is good telephone service on all of the large islands. Radiotelephone service is maintained between the islands and with the mainland of the United States.

RADIO SERVICE

The supervision of radio communication in the United States, including Alaska and the Hawaiian Islands, is controlled by the Federal Radio Commission.

The following publications may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C.

Commercial and Government Radio Stations of the United States (includes shore and ship stations).

Radio Service Bulletin (issued monthly to supplement the above publication; contains amendments and other information).

Amateur Radio Stations of the United States.

Time signals.—In connection with the service over the land telegraph wires, time signals by radio are sent daily from certain United States naval radio stations. American radio stations use a distinctive type of radio time signals known as The United States System.

The total duration of signal is 5 minutes. Preparatory or warning signals are omitted. The duration has been reduced to 3 minutes before the hour at all stations dependent upon commercially controlled telegraph wires. This change does not alter the existing time-signal code, since the last 3 minutes of the code are still used.

The signal consists of the transmission of a dot (.) for every second, omitting the twenty-ninth, fifty-first, fifty-sixth, fifty-seventh, fifty-eighth, and fifty-ninth second during the first minute; in the second minute the twenty-ninth, fifty-second, fifty-sixth, fifty-seventh, fifty-eight, and fifty-ninth second will be omitted; in the third minute the twenty-ninth, fifty-third, fifty-sixth, fifty-seventh,

fifty-eighth, and fifty-ninth second will be omitted; in the fourth minute the twenty-ninth, fifty-fourth, fifty-sixth, fifty-seventh, fifty-eighth, and fifty-ninth second will be omitted; in the fifth minute the twenty-ninth, fifty-first, fifty-second, fifty-third, fifty-fourth, fifty-fifth, fifty-sixth, fifty-seventh, fifty-eighth, and fifty-ninth second will be omitted; at the sixtieth second a 1-second dash (—) will be sent, the beginning of which is the time signal.

This is followed by the letters VA. In the event of an error occurring in the signal, another time signal will be transmitted one hour later on the same frequency.

Hydrographic information, weather reports, and other information of benefit to shipping are sent out from these and other naval radio stations along the coast.

Time signals are sent out from naval radio stations both at San Francisco and Honolulu. For details as to schedules, frequencies, etc., see Hydrographic Office Publication No. 205.

RADIOBEACONS

The U.S. Lighthouse Service operates radiobeacons in the Hawaiian Islands at the following places:

Makapuu Point Light
Kilauea Point Light

For details as to frequencies, geographic positions, signals, and thick and clear weather transmission, see Light Lists of the Lighthouse Service or Hydrographic Office Publication No. 205.

These radiobeacons are intended for the use of vessels equipped with radiocompasses. While the use of radiobeacons should not lead a mariner to neglect other precautions, such as the use of the lead, etc., during thick weather, the bearings will greatly reduce the dangers incident to navigation in the fog.

The bearing of the radiobeacon may be determined with an accuracy of approximately 2° and at distances considerably in excess of the range of visibility of the most powerful coast lights. The apparatus is simple and may be operated by the navigator without the assistance of a radio operator or without the knowledge of the telegraph code. The radio direction finding apparatus consists of a radio receiving set, similar in operation to those used for radio telegraph or telephone reception, and a rotatable coil of wire in place of the usual antenna. By rotating the coil, the intensity of the signal received from the transmitting station is made to vary, and by noting the position of the coil when the signal is heard at its minimum intensity, the bearing of the transmitting station is readily obtained.

It is important to note that the bearing of an incoming radio wave is subject to errors not unlike the deviation of the magnetic compass. Those using radio direction finding aboard ship are cautioned to bear these errors in mind and to keep the radiocompass calibrated at all times. This may be done during clear weather by comparing the bearing obtained with the radiocompass with the bearing as obtained by visual methods in general use. All radio bearings are subject to what is called "night effect", a variable error sometimes experienced near nightfall and sunrise. The

uncertainty due to this cause may be lessened by taking repeated radio bearings.

The signals from the radiobeacons have definite characteristics for identifying the station, and bearings may be obtained with even greater facility than sight bearings on visible objects.

A general description of this method of navigation and the instruments required is given in Lighthouse Service publication Radiobeacons and Radiobeacon Navigation, which may be obtained from the Superintendent of Documents, Washington, D.C., price 15 cents.

CONVERSION OF RADIO BEARINGS TO MERCATOR BEARINGS

The increasing use of radio directional bearings for locations of ships' positions at sea, especially during foggy weather, has made it particularly desirable to be able to apply these radio bearings taken on shipboard or sent out by the shore stations directly to the nautical chart. These radio bearings are the bearings of the great circles passing through the radio stations and the ship, and unless in the plane of the Equator or of a meridian, would be represented on a Mercator chart as curved lines. Obviously it is impracticable for a navigator to plot such lines on his chart, so it is necessary to apply a correction to a radio bearing to convert it into a Mercator bearing; that is, the bearing of a straight line on a Mercator chart laid off from the sending station and passing through the receiving station.

On page 9 is given a table of corrections for the conversion of a radio bearing into a Mercator bearing. It is sufficiently accurate for practical purposes for distances up to 1,000 miles.

The only data required are the latitudes and longitudes of the radiobeacons and of the ship by dead reckoning. The latter is scaled from the chart, and the former either scaled from the chart or taken from the list of radiobeacons found in the light list or Hydrographic Office Publication No. 205.

The table is entered with the difference of longitude in degrees between the ship and the station (the nearest tabulated value being used), and opposite the middle latitude between the ship and station, the correction to be applied is read.

When the bearings are taken from the ship, the sign of the correction (bearings read clockwise from the north) will be as follows: In **north latitude,** the *minus sign* is used when the ship is *east of the radiobeacon* and the *plus sign* is used when the ship is *west of the radiobeacon.* In **south latitude,** the *plus sign* is used when the ship is *east of the radiobeacon*, and the *minus sign* is used when the ship is *west of the radiobeacon.*

To facilitate plotting, 180° should be added to the corrected bearing, and the result plotted from the radiobeacon.

Should the position by dead reckoning differ greatly from the true position of the ship as determined by plotting the corrected radio bearings, a retrial should be made, using the new value as the position of the ship.

Example.—A ship in latitude 26°00′ N., longitude 157°00′ W., by dead reckoning, obtains a radio bearing of 236° true on the radio-

beacon at Makapuu Lighthouse located in latitude 21°19′ N., and longitude 157°39′ W.

	° ′		° ′	
Radiobeacon station latitude	21 19	N., long.	157 39	W.
Dead-reckoning position of ship	26 00		150 00	
Middle latitude	23 40	Difference	7 39	

Entering the table with difference of longitude equals 7½°, which is the nearest tabulated value, and opposite 24° middle latitude, the correction of 1.5° is read.

The ship being east of the radiobeacon, the correction is minus. The Mercator bearing will then be 236° − 1.5° = 234.5°. To facilitate plotting, add 180° and plot from the position of the radiobeacon, thus: 234.5° + 180° = 414.5° or 54.5°, which is the true bearing to be laid off from the position of the radiobeacon.

If the bearing is from a shore station, the signs will be reversed to those given above.

Table of corrections

[Difference of longitude in degrees

Mid. L.	1°	1½°	2°	2½°	3°	3½°	4°	4½°	5°	5½°	6°	6½°	7°	7½°	8°	8½°	9°	9½°	10°
°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°	°
4	----	----	----	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3
5	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4
6	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.5
7	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6
8	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6	0.7	0.7
9	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.8
10	0.1	0.1	0.1	0.2	0.2	0.3	0.4	0.4	0.4	0.5	0.5	0.6	0.6	0.6	0.7	0.7	0.8	0.8	0.9
11	0.1	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.8	0.9	1.0
12	0.1	0.1	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	0.9	1.0	1.0
13	0.1	0.2	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.1
14	0.1	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.2
15	0.1	0.2	0.3	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.2	1.3
16	0.1	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8	0.8	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.4
17	0.2	0.2	0.3	0.4	0.4	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.2	1.3	1.4	1.5
18	0.2	0.2	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.1	1.2	1.2	1.3	1.4	1.5	1.6
19	0.2	0.2	0.3	0.4	0.5	0.6	0.6	0.7	0.8	0.9	1.0	1.1	1.1	1.2	1.3	1.4	1.5	1.6	1.6
20	0.2	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.5	1.6	1.7
21	0.2	0.3	0.4	0.5	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.2	1.4	1.4	1.5	1.6	1.7	1.8
22	0.2	0.3	0.4	0.5	0.6	0.6	0.8	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9
23	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.8	2.0
24	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0
25	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1
26	0.2	0.3	0.4	0.6	0.6	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.8	1.9	2.0	2.1	2.2
27	0.2	0.3	0.4	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.4	1.5	1.6	1.7	1.8	1.9	2.1	2.2	2.3
28	0.2	0.4	0.5	0.6	0.7	0.8	0.9	1.1	1.2	1.3	1.4	1.5	1.6	1.8	1.9	2.0	2.1	2.2	2.4
29	0.2	0.4	0.5	0.6	0.7	0.8	1.0	1.1	1.2	1.3	1.4	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.4
30	0.2	0.4	0.5	0.6	0.8	0.9	1.0	1.1	1.2	1.4	1.5	1.6	1.8	1.9	2.0	2.1	2.2	2.4	2.5
31	0.2	0.4	0.5	0.6	0.8	0.9	1.0	1.2	1.3	1.4	1.6	1.7	1.8	1.9	2.1	2.2	2.3	2.5	2.6
32	0.3	0.4	0.5	0.7	0.8	0.9	1.1	1.2	1.3	1.4	1.6	1.7	1.8	2.0	2.1	2.2	2.4	2.5	2.6
33	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.2	1.4	1.5	1.6	1.8	1.9	2.1	2.2	2.3	2.4	2.6	2.7
34	0.3	0.4	0.6	0.7	0.8	1.0	1.1	1.2	1.4	1.5	1.7	1.8	2.0	2.1	2.2	2.4	2.5	2.6	2.8
35	0.3	0.4	0.6	0.7	0.9	1.0	1.2	1.3	1.4	1.6	1.7	1.9	2.0	2.2	2.3	2.4	2.6	2.7	2.9
36	0.3	0.4	0.6	0.7	0.9	1.0	1.2	1.3	1.5	1.6	1.8	1.9	2.1	2.2	2.4	2.5	2.6	2.8	2.9
37	0.3	0.4	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.6	1.8	2.0	2.1	2.2	2.4	2.6	2.7	2.9	3.0
38	0.3	0.5	0.6	0.8	0.9	1.1	1.2	1.4	1.5	1.7	1.8	2.0	2.2	2.3	2.5	2.6	2.8	2.9	3.1
39	0.3	0.5	0.6	0.8	1.0	1.1	1.2	1.4	1.6	1.7	1.9	2.1	2.2	2.4	2.5	2.7	2.8	3.0	3.2
40	0.3	0.5	0.6	0.8	1.0	1.1	1.3	1.4	1.6	1.8	1.9	2.1	2.2	2.4	2.6	2.7	2.9	3.1	3.3

Weather reports.—The U.S. naval radio station at Honolulu, Hawaii, (NPM; 500 kc.) broadcasts weather reports daily, except Sunday, at 12 noon (157°30′ west longitude time).

Free medical advice to seamen by radio.—The U.S. Public Health Service maintains the following station on the Pacific coast from which free medical advice by radio may be obtained direct:

San Francisco, Calif., U.S. Marine Hospital No. 19.

Governmental and commercial radio stations will transmit free messages addressed to the above station. In order to avoid confusion and to make the practice uniform, all messages for transmission will be signed "Marine Hospital No. 19."

All coastal stations operated by the Radiomarine Corporation of America offer free medical service to ships of all countries.

Messages received from masters of vessels reporting symptoms observed in a sick member of the crew are promptly forwarded to the nearest U.S. marine hospital, where the case is diagnosed by the medical staff from the information given in the master's message. A course of treatment is then decided upon and suitable instructions transmitted to the vessel.

No charge is made for the radiotelegraph service on such messages when they are prefixed by "D H Medico."

The following is a list of Radiomarine Corporation of America stations located on the Pacific coast:

Bolinas, Calif. (*KPH*).—500 kc (600 m), 22,100 kc (13 m) A1, A2. Lat. 37°54′12″ N. Long. 122°42′30″ W.

Torrance, Calif. (*KSE*).—500 kc (600 m), 22,520 kc (14 m) A1. Lat. 33°49′06″ Long. 118°21′22″ W.

Portland, Oreg. (*KPK*).—500 kc (600 m), A1, A2. Lat. 45°36′18″ N. Long. 122°46′00″ W.

Aberdeen, Wash. (*KZE*).—500 kc (600 m) B. Lat. 46°59′00″ N. Long. 123°50′00″ W.

WEATHER

Owing to the location of the islands, the climate is equable, the mean monthly temperature at Honolulu varying from 71° in January to 78°.4 in August. In the higher elevations of the larger islands, however, much lower temperatures prevail. During the winter months, snow is often seen on the higher peaks of the island of Hawaii.

The meteorological tables in the appendix give the average weather conditions at Honolulu.

Winds.—The northeast trade winds prevail throughout the year. During the summer months they are almost continuous and usually veer a little to the north of the average direction. During the winter months they are apt to be interrupted by variable winds, or by "*konas*", the local name for strong southerly or southwesterly winds, which sometimes occur. The trades veer more to the easterly in the winter. The konas, which occasionally occur between October and April, last from a few hours to two or three days and are attended by rain. During the konas all anchorages on the lee side of the islands are unsafe. "Kona weather" is frequently no more than a period of light southerly breezes; strong kona storms are rare.

While the trade winds are blowing, frequent calms and light variable winds may be found for several miles to leeward of the larger islands. Along the west coast of Hawaii and the south coast of Maui the land and sea breezes are very regular, the wind blowing on shore during the day and offshore at night. In general, fair weather may be expected from May to October.

Rainfall.—The rainfall in the Hawaiian Islands varies greatly in the different localities and is influenced by the location with respect to winds and mountains. The greatest rainfall is usually found on the windward side of the islands. In general, the winter is the rainy season, although there is no month without some rain. From observations made at different stations it is found that the amount of rainfall often varies greatly at the same station for the same months in different years or for the total rainfall of different years. In the vicinity of Mount Waialeale, Kauai, there is an annual rainfall of over 400 inches, while the island of Kahoolawe receives scarcely enough rain to support vegetation.

Fog does not occur around the islands, and except for rain squalls, mist, and haze, there is no thick weather. The mountains on the islands, however, are often obscured by clouds.

Storm warnings.—No storm warnings are displayed in the Hawaiian Islands, but special forecasts are made from the Weather Bureau station at Honolulu. Mariners and others may have their barometers compared with standards at that station, which is located in the Federal Building.

TIDES

The periodic tides in the vicinity of the Hawaiian Islands are usually small, the average rise and fall being from 1 to 2 feet (0.3 to 0.6 m). The high-water intervals vary from 2 to 3¾ hours, and, in general, the tides occur from about 1 to 1½ hours earlier along the northern coasts than they do along the southern coasts of the islands.

Tide tables for the Pacific Ocean and Indian Ocean, including the Hawaiian Islands, are published annually in advance by the U.S. Coast and Geodetic Survey. This volume furnishes, at the nominal cost of 25 cents, full tidal data for the Pacific coast of North America and the island groups, as well as for the Indian Ocean.

It contains a table of full daily predictions of the times and heights of high and low waters for certain reference or standard ports, including the port of Honolulu, and also tidal differences for a number of other places in the Hawaiian Islands. Full explanations for the use of the tables are given in the volume.

The minus sign before the predicted heights in the tide tables indicates that the water is below the plane of reference, which is mean lower low water.

Caution.—In using the Tide Tables, slack water should not be confounded with high or low water. For ocean stations there is usually but little difference between the time of high or low water and the beginning of ebb or flood currents; but for places in narrow channels, landlocked harbors, or on tidal rivers the time of slack

current may differ by 2 or 3 hours from the time of high or low water stand, and local knowledge is required to enable one to make the proper allowance for this delay in the condition of tidal currents.

The figures given in tables 1 and 2 of the Tide Tables are the times of high and low water, and these times are not necessarily the times of slack water.

CURRENTS

The currents, as a rule, are influenced by the direction and strength of the trade winds. In general, in the vicinity of the Hawaiian Islands, there is a westerly set due to the prevailing northeasterly trade winds. In the channels between the larger islands, however, the currents are tidal, but are influenced both by the wind and the positions of the islands in respect to one another.

The currents seem to rotate in a clockwise direction around the small islets to the westward of the main group, but a few miles away from them the prevailing set is westerly.

DESCRIPTIONS AND SAILING DIRECTIONS

HAWAII (CHART 4115)

the largest of the islands, is at the southeast end of the group. It is irregular in shape, resembling a triangle, and has a greatest length of 83 miles north and south and a greatest width of 73 miles. The island is dominated by the two principal peaks, Mauna Loa and Mauna Kea, each almost 14,000 feet (4,267 m) high, from the summits of which the land slopes gradually to the coast, with occasional cinder cones and lesser peaks intervening. In the central western part of the island Mount Hualalai rises to an altitude of 8,269 feet (2,520 m), while in the northwestern part Mount Kohala, elevation 5,505 feet (1,678 m), dominates the Kohala Peninsula. Hawaii, being the youngest of the islands, shows evidences of recent volcanic activity in the numerous lava flows, some of which reach the coast, and in the various cinder cones dotting the slopes. The only active volcanoes in the Hawaiian group, Mauna Loa and Kilauea, are located on this island.

Population.—By the census of 1930 Hawaii had 73,325 inhabitants.

Winds.—The easterly trade winds seem to divide at Cape Kumukahi, part following the coast northwestward around Upolu Point, where it loses its force, the other part following the southeast coast around Kalae, where it loses its force. On the west coast of Hawaii, except at Mahukona, the sea breeze sets in about 9 a.m. and continues until after sundown, when the land breeze then springs up. Vessels from westward bound to ports on the windward side of Hawaii should pass close to Upolu Point and keep near the coast, as the wind is generally much lighter than offshore. Sailing vessels from westward bound to ports on the eastern side of Hawaii should keep well northward until clear of Alenuihaha Channel.

During the trades the Hamakua coast (northeast) is frequently clouded over in the early morning, with clear weather a mile or two offshore; but when the breeze picks up, about 9 a.m., the clouds are driven inland.

Rainfall.—The rainfall of the island of Hawaii varies greatly in different localities. The largest amount is found along the windward side. There is moderate rainfall on the Kona district highlands, while a little reaches the Kau district and the west coast.

Anchorages are numerous except on the northeast and southeast coasts, the first requirements under ordinary conditions being shelter from the northeast trades. In many places, however, the coast is steep-to and anchorage is impracticable.

Highways.—There is an automobile highway entirely around the island.

Telephone.—There is communication by telephone to all parts of the island and by radio and radiotelephone to the other islands and to the mainland of the United States.

Currents.—Generally the currents follow the trades, but occasionally they set against the wind. A current follows the coast north of Cape Kumukahi around Upolu Point; another one follows the trend of the coast offshore southwestward from Cape Kumukahi around Kalae and northward as far as Upolu Point. There is also a countercurrent inshore that sets southward from Okoe Landing along the west coast around Kalae and thence northeastward along the shore as far as Keauhou. Northward from Okoe Landing the prevailing current inshore is northerly and at times quite strong.

NORTHEAST COAST OF HAWAII (CHART 4115)

From Upolu Point to Cape Kumukahi, a distance of 80 miles, the coast has a general southeasterly trend; it is only partially surveyed, but is generally bold. The only known outlying dangers are shoals off Kauhola Point, off Honokaneiki Gulch, and Blonde Reef in Hilo Bay. All dangers will be avoided by giving the coast a berth of about 2 miles. There are no harbors or sheltered anchorages on this coast except Hilo Bay. At some of the landings freight is handled by local vessels by means of a wire cable. When running the coast at night, it will be found that the electric lights of the various sugar mills define the coast fairly well.

Upolu Point, the northernmost point of Hawaii, is hard to identify. There are numerous bluffs, forming headlands, in the vicinity, all of which are quite similar from seaward. The country back of the point is covered with sugarcane, and here and there may be seen clumps of trees, among which are generally situated the camps and villages.

The camps are high up on the bluffs and at night the lights are visible for a considerable distance. There is an abandoned mill stack at **Hawi,** midway between Upolu and Kauhola Points and 1 mile inland. The stack is grayish in color and may be seen from offshore.

Kauhola Point, 7 miles eastward of Upolu Point, is a low point of land marked by a flashing red and green light, off which a dangerous reef, generally marked by breakers, extends ⅓ mile. Vessels should give this point a berth of 1 mile. A fair anchorage, used by local vessels, can be had in **Awaeli Harbor,** in 9 fathoms (16.5 m), with Kauhola Point light bearing 90° true (E. by N. mag.), distant ⅓ mile. Protection can be had here for vessels forced to leave anchorages on the west coast during strong kona storms. In leaving this anchorage, bound eastward, steer 10° true (N. mag.) for 1¼ miles to clear the

reef. **Kohala,** the principal village of the vicinity, is located a mile inland from the light.

Keokea (white) **Harbor,** 1½ miles southeast of Kauhola Point, is an abandoned shipping point. It cannot be recommended as an anchorage when the trade winds are blowing.

Niulii Plantation, about 1 mile southeast of the harbor, is the eastern terminus of the Hawaii Railway, which is engaged in the transportation of freight from the various plantations along the Kohala coast to Mahukona.

Akokoa Point, 3 miles eastward of Kauhola Point, marks the easterly limits of the sugar plantations in the Kohala district. Southeastward of this point the country has the appearance of a large tableland, rising gradually to the Kohala Mountains, which are heavily wooded to their summits.

The coast between Akokoa Point and Waipio Gulch, a distance of about 10 miles, consists of numerous precipices, ranging in heights up to 1,300 feet (396 m), and deep gorges that extend back into the country. There are also numerous waterfalls. The faces of the precipices present a general brownish appearance, although in places they are covered with vegetation from the top to the sea.

Pololu Gulch, 1 mile south of Akokoa Point, is the westernmost gorge. Rice is cultivated in this valley. Two small detached rocks lie 250 yards offshore from the east edge of the gulch.

Honokane Gulch, ½ mile from Pololu Gulch, is used somewhat for taro raising.

Honokaneiki Gulch, 1½ miles southeast from Akokoa Point, is a narrow gulch opening into a narrow bay that affords good protection and landing facilities for small boats. A rock awash at low water lies ½ mile offshore and 1¾ miles southeast from Akokoa Point. The southerly end of the rock is awash at low water, while the northerly end, 80 yards distant, has a depth of 23 feet (7 m). The depth of the surrounding water is from 12 to 14 fathoms (21.9 to 25.6 m). Two small rocky islands, the larger having a height of 230 feet (70 m), are situated 300 yards offshore, about ¾ mile east of Honokaneiki Gulch. Between Akokoa Point and these two islands the bottom is fairly regular and slopes gradually from the coast to the 20-fathom (37 m) curve, about ¾ mile offshore. Anchorage may be had in offshore winds in depths from 7 to 20 fathoms (12.8 to 37 m).

Six miles beyond Akokoa Point is a rounding point projecting 300 yards beyond the cliff line and is the result of a landslide from the cliffs. Small boats sometimes land on the smooth shingle beach about 200 yards west of the house situated near the westerly end of the point. This place is sometimes referred to as Laupahoehoe, but must not be confused with Laupahoehoe Point and village, 26 miles farther eastward.

Waimanu Valley, 7 miles from Akokoa Point, cuts through the highest cliffs in the vicinity and ranks second in size among the gulches of this coast. The bay fronting the valley may be used as anchorage in favorable weather. A depth of 7 fathoms (12.8 m) is obtained ¼ mile offshore just off the middle of the gulch. A rounding point extending 300 yards beyond the cliff line between Waimanu Valley and Waipio Gulch was formed by a landslide about 1910,

leaving a bare, yellow scar on the face of the bluff that is quite prominent from offshore.

Waipio Gulch, the largest along this coast, is 3 miles from Waimanu Valley. It is a remarkable opening in the bluffs and is easily recognized by the sheer sides. Rice is grown here and a small village is situated near the mouth. Anchorage may be had in favorable weather conditions in 7 to 9 fathoms (12.8 to 16.5 m) ¼ mile offshore, either off the mouth of the valley or under the bluffs to the eastward, but not beyond **Honokaape Landing,** located ¾ mile beyond the east edge of the valley. There is a small breakwater at the landing which was built for the barging of rock for the Hilo breakwater. It has been damaged by seas, and offers practically no protection.

From Waipio Gulch the precipices become lower until, at Kukuihaele Landing, 2 miles distant, the coast is a comparatively low bluff from 30 to 300 feet (9.1 to 91 m) high. Between Waipio Gulch and Hilo the country to an elevation of about 2,000 feet (610 m) is covered with sugarcane. Beyond this, extending upward toward Mauna Kea, it is wooded to an elevation of about 2,600 feet (792 m), and from here up the mountains present a barren appearance. During the winter months **Mauna Kea** is frequently snowcapped.

Kukuihaele Landing (chart 4162), 2 miles eastward of Waipio Gulch, is marked by a flashing white light 400 yards east of the large cable house which stands at the rim of the 250-foot (76 m) cliff. The shore line is made up of huge bowlders strewn along the foot of sheer cliffs. Steamers moor to privately owned buoys and handle freight over two cables; sugar loading can be maintained at the rate of 170 tons per hour. Unless it is calm, steamers leave the mooring buoys at night and anchor off Waipio Gulch, 2 miles westward. A line of ocean-going steamers calls here regularly for sugar.

Honokaa Landing (chart 4162), 5 miles southeastward of Kukuihaele Landing, is marked by the foundations of the landing buildings and three black oil tanks on the low bluff, the cable house and warehouses having been destroyed by fire. Southeastward and close to the landing is a high trestle over a gulch. A mill is located 1 mile southward of the landing and its lone white stack can be seen among a large clump of trees. A reef, over which the sea usually breaks, extends for 170 yards northward from the landing foundations. There are several bare, detached rocks on the reef, but these do not mark its offshore limits. There is no shelter here during normal weather, as it is open to the north and east. Oil tankers call infrequently, but the landing is no longer used for general freight.

Paauhau Landing, 2 miles southeastward of Honokaa, is marked by the white masonry of the inclined railway which leads from the landing to the top of the bluff. A mill with a prominent tall stack is situated on the bluff just south of the landing. A deep gulch makes in on each side of the mill, and the southern one is spanned by a trestle. A 1,000-foot (305 m) loading wire leads from the large cable house on the cliff to the mooring buoys. Local steamers call here regularly for freight. They moor to the buoys, heading about 78° true (ENE. mag.), in from 6 to 9 fathoms (11 to 16.5 m). When approaching the mooring buoys, anchors are dropped in deeper water to the northward to assist in departing. The shore

consists of rocks and ledges, over which the seas break constantly, at the foot of steep cliffs. The small concrete boat landing at the foot of the masonry incline offers but little protection from the northeast trades.

Paauilo is a village about 5 miles southeastward of Paauhau and 1 mile inland. It is the western terminus of the Hawaii Consolidated Railway. This railroad handles all freight between Paauilo and Hilo. All wire landings between these points formerly used have been abandoned. A mill with dark-colored stack is located near the top of the bluff and directly seaward from the village.

Koholalele, 6 miles southeastward of Paauhau, is an abandoned landing. The remains of the old landing are not conspicuous from seaward.

Kukaiau, about ¾ mile southeastward of Koholalele, has been abandoned as a mill site and landing. The buildings and stack have been destroyed. The bluffs are higher and more thickly covered with vegetation than those northwestward.

Ookala mill, 3½ miles southeastward of Kukaiau, is on the edge of the bluff on the south side of a deep gulch, which is spanned by a high railroad trestle. The red-roofed plantation houses are situated both north and south of the mill and are noticeable for their regular arrangement. At night the rows of bright lights of the settlement are conspicuous.

Kaawalii Gulch, about 1½ miles southeast from Ookala mill, is V-shaped. There is a pumping station with black stack close to the beach. The country back of the coast line changes slightly in appearance in this locality. Hummocky fields are noticeable.

Laupahoehoe Point, marked by a flashing white light, and 3 miles southeastward of Ookala mill, is low and flat and makes out about ¼ mile from a deep gulch. The seaward end of the point is a mass of black lava rock, which is broken up into detached ledges extending ⅛ mile out from the light. The sea usually breaks with considerable force over the ledges. **Laupahoehoe** village is located on the inshore end of the point, but some of the buildings are on the bluff to the southward. There is a group of cottages and a school building among coconut trees between the village and the point. The boat landing, which has fallen into disuse, is located in a 30-foot (9.1 m) opening in the rocks on the southeast side of the point. While there is some protection for small boats, it is not recommended when there is much of a swell running.

Papaaloa, 1½ miles southeast from Laupahoehoe, can be identified by a waterfall directly under the mill and white stack on the edge of the bluff. There is a horizontal string of bright lights which makes a good mark at night.

Maulua Bay, 1¾ miles southeast of Papaaloa, is a ¼-mile indentation in the coast at the mouth of a gulch which is spanned by a high railroad bridge. There is a shingle beach at the head of the bay where small boats could be beached during favorable weather. There is only slight protection from the northeast trades. **Ninole** village is 1½ miles southeast from the bay.

Honohina, about 7 miles southeast of Laupahoehoe, is a settlement on the plain between two gulches. There are no stacks or prominent buildings to be seen from seaward. The land has lost

its hummocky appearance, and the cane-covered fields have a more level appearance, but are still broken by the gulches. Between here and Hilo the cliffs gradually decrease in height until at Hilo the bluffs disappear.

Hakalau Bay, about 8½ miles southeastward of Laupahoehoe Point, lies in the mouth of the Hakalau Gulch. A high railroad trestle spanning the gulch is prominent from offshore, as are also the silver colored mill and other buildings lying in the gulch at the base of the south bank. There are several buildings on the highland just south of the gulch, quite close to the edge of the bluff. At night a row of prominent lights extends from this highland down to the gulch.

Wailea, a settlement about 1 mile south of Hakalau, is situated a short way inland, and just north of **Kolekole** (red earth) **Gulch.**

Honomu mill, about 2¼ miles southeastward of Hakalau Bay, is situated down in the mouth of the gulch. The mill stack is black and not very prominent. About 2 miles northward of Pepeekeo Point the water falls cease to be a characteristic of the coast.

Alia Point, 1¾ miles southeastward of Honomu mill, is not very prominent.

Pepeekeo Point, marked by a group flashing white light, is about 2½ miles southward of Honomu mill. It is the most prominent point in the vicinity. Pepeekeo mill is located on the bluff south of the point. The white stack of the mill must not be mistaken for the light, which is on a white skeleton tower. The cane-covered cinder cones, 2 miles inland from Pepeekeo Point Light, are fairly prominent. **Kauku Crater,** 4½ miles inland from the light, is wooded and 1,956 feet (596 m) high. Cane fields extend from the coast to the foot of this crater.

Onomea, a settlement about 2 miles south of Pepeekeo, is situated above the slope at the head of Onomea Bay. A prominent feature is a large building with a black roof. The bay is small, shallow, and foul, but with local knowledge some protection for small boats can be had when the trades are northerly. A natural arch marks the seaward end of the ridge which forms the north side of the bay.

Papaikou is a large settlement about 2 miles south of Onomea.

Paukaa Point, about 1 mile south of Papaikou, is marked by a flashing white light 145 feet (44 m) above the water.

HILO BAY (CHART 4103)

about 60 miles southeastward of Upolu Point and 20 miles northwestward of Cape Kumukahi, is included between Koekea Point on the south and Pepeekoe Point on the north, a distance of 7 miles, and indents the coast about 3 miles. The westerly shore of the bay is bluff, while the southerly and easterly shores are low. The outer bay is exposed to the northeast trades, but the harbor is sheltered by a breakwater extending northwestward over Blonde Reef from the wharves at Kuhio Bay. There is frequently a heavy swell which is deflected eastward by the west shore and causes a considerable surge at the wharves.

Hilo, the second in commercial importance and population of the cities of the Hawaiian Islands, is situated on the southwesterly side of the bay. From Hilo eastward along the beach numerous houses

are scattered as far as the two large territorial wharves at Kuhio Bay. Many small boats find protection in the quiet waters of **Waiakea Creek**, at the eastern edge of the city.

Prominent features.—Hilo Sugar Co.'s mill, about 1 mile northward of Hilo, at Alealea Point, is painted gray and has one large black stack. At the water's edge just southward of the mill is a high white stone abutment. When the mill is in operation at night, it will be recognized by the number of electric lights that are scattered about the plant. **Green** (Halai) **Hill**, 1 mile southwestward of Hilo, is the highest point in the vicinity. It has some cane and a few scattered trees on the slopes, but the entire hill is being developed as a residential district. The high concrete stack of the Hilo electric plant at Waiakea is very prominent and is an excellent leading mark to the harbor. At night the Waiakea fixed red light is seen for a considerable distance before picking up Blonde Reef lighted entrance buoy, which is 500 yards west of the end of the breakwater. Cocoanut Point beacon is a small white tower on sea wall 200 yards southeast of the mouth of Wailuku River. There are two radio towers 500 yards east of the territorial wharves. There is an airplane landing field about 1 mile southward of the wharves.

Ranges.—A lighted range marks the channel south of Blonde Reef to the wharves in Kuhio Bay.

Pilotage is not compulsory, but certain fees are charged to vessels entering or departing with or without a pilot. Pilot rates are given in the Appendix.

Towboats.—There are no towboats. A privately owned launch is available for handling mooring lines.

Anchorage can be had anywhere under the lee of the breakwater in up to 7 fathoms (12.8 m). Anchorage north of the black can buoys is not recommended. A good anchorage in from 5 to 6 fathoms (9.1 to 11 m) with good holding ground is 3/8 mile 270° true (W. by S. mag.) from Kaulainaiwi Island. After heavy rains a current setting northward from Waiakea Creek is felt in this vicinity. For deep-draft vessels the harbor master usually assigns an anchorage 1/2 mile east of Alealea Point, in 46 feet (14 m).

Wharves.—There are two large modern wharves, owned and operated by the Territory, at the eastern end of the breakwater in Kuhio Bay. Both wharves are well equipped for handling freight. The northeasterly one is 400 yards long and is used for trans-Pacific freight, while the southwesterly one is used for interisland freight. The northeasterly wharf (Pier 1) has from 34 to 36 feet (10.4 to 11 m) except at the extreme ends, where some shoaling has occurred. The southwesterly wharf (Pier 2) has 31 feet (9.4 m) along the northeast side, 33 feet (10.1 m) on the southwest side, and 27 feet (8.2 m) at the outer end.

Harbor regulations.—The harbor master, who is also the pilot, has charge of the anchorages.

Supplies.—Provisions, ice, lumber, and some ship chandler's stores can be obtained. Water, fuel oil, and gasoline can be conveniently obtained at the wharves at Kuhio.

Repairs.—There are machine shops where extensive repairs can be made. There are no dry docks or large marine railways.

Winds.—The prevailing winds are the northeast trades. At night a gentle breeze generally comes off the land.

Tides.—The mean range of tides is 1.8 feet (0.5 m).

Directions.—*From eastward*, give Leleiwi Point a berth of 1 mile in rounding it and steer 280° true (W. mag.) for 4½ miles, heading for Paukaa light until ½ to ¾ mile from shore; then steer 184° true (S. ½ E. mag.) keeping this distance offshore and taking care to pass westward of Blonde Reef lighted bell buoy. Anchor southward of the black can buoys marking the southwesterly edge of Blonde Reef. (See "Anchorage.") *If bound for the wharves* in Kuhio Bay, after passing Blonde Reef lighted bell buoy haul eastward slowly, leaving black buoy (can, 3) to port. Then steer 97° true (E. ⅜ N. mag.) with Kuhio Bay range lights ahead. Pass between the buoys marking the edges of the shoals on each side of the channel. In 1931 this channel had a depth of 36 feet (11 m).

There are large mooring buoys in Kuhio Bay. The larger vessels drop anchor as well as make fast to the mooring buoys when coming alongside Pier 1. This is necessary to assist in leaving and for breasting off when the surge at the wharf is excessive.

From northward, after rounding Pepeekeo Point, steer 184° true (S. ⅝ E. mag.), keeping ½ to ¾ mile offshore and taking care to pass westward of Blonde Reef lighted bell buoy and continue as directed in the preceding paragraph.

Dangers.—The lead is generally a good guide on the south side of the bay, but the shoaling is abrupt to Blonde Reef and the reefs around and eastward of Cocoanut Island. A large fleet of fishing sampans operates in the outer bay. The movements of these boats are uncertain, and vessels approaching the bay must maintain a sharp lookout.

Blonde Reef is an extensive sunken reef, with depths of 1 to 4 fathoms (1.8 to 7.3 m), which extends 1½ miles in a west-northwesterly direction from the easterly side of the bay. The shoaling is generally abrupt on all sides of the reef, and the lead cannot be depended on to clear it. A Government breakwater extends over the reef to within 150 yards of its western edge. It is marked off the westerly end by a black, lighted bell buoy, and on its southerly edge by black can buoys. The entrance to the harbor is ¾ mile wide between Blonde Reef and the westerly shore.

Mokuola (Cocoanut) **Island** (wooded) and the bare islets (Kaulainaiwi Island) northward are connected with the shore by a reef, which makes out 150 to 200 yards on all sides of them. The north end of the reef is marked by a lighted buoy. Shoals with 6 to 8 feet (1.8 to 5.5 m) extend out a distance of ⅛ to ¼ mile all along the southerly side of the bay.

HILO BAY TO CAPE KUMUKAHI (CHART 4115)

Keokea Point, about 3 miles eastward of Hilo, is low and hard to distinguish from other points in the vicinity. There are a few cocoanut trees on the point. Foul ground extends for ½ mile offshore.

Leleiwi Point, 5 miles eastward of Hilo, is marked by a mass of bare black lava rock about 20 feet (6.1 m) high, which extends 100 yards seaward from the tree line. It is particularly hard to pick up

at night, as it is low and seldom shows any lights. The coast between Hilo and Leleiwi Point is low and covered with a dense growth of pandanus and guava trees, back of which is a low, heavily wooded flat plain. The shore is broken by low patches of black lava.

Olaa mill, 6½ miles southward of Leleiwi Point and 3½ miles inland, is marked by a tall white stack and a prominent white water tank. At night the electric lights of the mill can be seen some distance at sea. Between Olaa mill and Cape Kumukahi the land is low and level and is wooded for a distance of about 2 miles from the shore. Beyond this the Olaa plantation rises to an elevation of about 2,000 feet (610 m), back of which may be seen the forests. The coast between Leleiwi Point and Cape Kumukahi, a distance of about 17 miles, is a series of low bluffs. The lava flow of 1840, which reaches the sea 5 miles nothwestward of Cape Kumukahi, is marked on its seaward end by two black hills about 50 feet (15.2 m) high, which lie close together. This lava flow is visible inshore for a distance of about 5 miles. The plain northwestward of the cape is thickly covered with foliage and scattered cocoanut groves.

Cape Kumukahi, the easternmost cape of Hawaii, is a low mass of bare black lava with a jagged top, and is clearly defined from all sides. It is marked by a light, which is about 400 yards in from the point. Sharply defined pinnacles mark the end of the point. A chain of old craters, or cinder cones, extends 7 miles southwesterly from the cape. The first cone is 1⅜ miles west of the cape, 245 feet (75 m) high, and is surmounted by scattered cocoanut trees. The trade winds divide at the cape, part following the coast northwestward and the other part following the coast southwestward; sailing vessels should, therefore, give the cape a berth of about 2 miles in rounding it.

Pahoa is a plantation village 8½ miles west of Cape Kumukahi and is marked by a large church with red roof and spire. There is no mill here. The Hilo Railroad eastern terminus is **Kapoho,** a settlement about 2 miles west of the cape.

SOUTHEAST COAST OF HAWAII (CHART 4115)

From Cape Kumukahi to Kalae (South Cape), a distance of about 63 miles, the coast has a general southwesterly trend; it is not surveyed but is generally bold, and it is advisable for vessels to keep about 1 mile offshore. There are no sheltered harbors or anchorages on this coast that afford shelter during all winds. Honuapo is the only landing where steamers call.

The country southwest of Cape Kumukahi is heavily wooded and along the beach are numerous coconut groves. The shore in the vicinity of the cape is low, growing higher southwestward. The rocks are of black lava formation. The characteristic features of this coast are the lava flows, which reach from the hills to the water's edge; they present a bare and rough appearance. The old craters heretofore mentioned as extending southwestward from the cape, join the ridge which forms the divide between the Puna and Kau districts.

Pohoiki is an abandoned landing 4 miles southwestward of Cape Kumukahi. The red-roofed coffee mill (abandoned) with small gray stack is 200 yards inland. There are several large trees with dark-green foliage on the small point seaward from the mill. Pull-

ing boats can be beached on the shingle and gravel beach on the south side of the point.

Honuaula Crater, about 5 miles southwestward of Cape Kumukahi and 3 miles inland, is 844 feet (257 m) high and quite prominent. The southeast side is blown out, but the remaining slopes are covered with cane fields, while the rim is fringed with trees.

Opihikao Village, about 7 miles southwestward from Cape Kumukahi, is marked by a prominent grass-covered mound, 125 feet (38 m) high, near the beach about 1 mile northeastward of the village. The village is situated among coconut trees. There is a small church with steeple near the beach.

Kaimu Village (Black Sand Beach), about 6 miles southwest of Opihikao, has a black sand beach that may be used as a landing place. The beach is steep and free from rocks. A small red church is situated near the beach on the north side of the village, which consists of only 3 or 4 houses among coconut trees.

Kalapana Village, 7 miles southwestward of Opihikao, is marked by a red-roofed pavilion and a white church with square tower. These buildings are close together, near the sand beach, and 150 yards seaward of a yellow church with red spire. The village is situated on the low ground on the north side of **Hakuma Point,** a black, flat-topped headland 50 feet (15.2 m) high. This is the most prominent point in the vicinity, and obscures the village from the southwest. About ¼ mile northeastward of the village is a thick grove of pandanus trees.

Kii Village, 2½ miles southwestward of Kalapana, consists of a few scattered houses between which are coconut trees. The coast in this vicinity is of black lava, 20 to 50 feet (6.1 to 15.2 m) high. The slopes in back of Kii are covered with low vegetation for about 3 miles to the first hills, which are forest covered.

Apua Point, 12 miles southwest of Kii, is a low, bare point. Shoal water extends off the point for 300 yards or more. It is reported that a steamer touched bottom off this point and vessels should give it a berth of at least 1 mile.

Keauhou Landing is 2½ miles westward of Apua Point. At this point the bluffs are yellow, steeper, and near the beach. The plain at the foot of the bluffs is low, and on a dark night the beach is hard to see. About 2 miles westward of Keauhou is a yellow bluff about 300 feet (91 m) high at its northeasterly end. This is the most prominent landmark near the beach on this part of the coast. About 3½ miles west of Apua Point there is a low islet close inshore, almost joined to the mainland at its easterly extremity by shoal water. Small boats find shelter behind this island by entering from the west.

Between the prominent point 1 mile southwestward of Kii (Kupapau Point) and Keauhou the plain along the shore and the lower slopes of the mountains are devoid of vegetation; higher up the mountains are wooded. Beginning at a point about 10 miles east of Keauhou there are a series of bluffs several hundred feet high from 1 to 3 miles back from the shore. The bluffs are marked by numerous lava flows. The volcano of Kilauea cannot be seen from seaward, but its location can be told approximately in the daytime by the smoke which it discharges and at night by the glare on the clouds when active.

Kau Desert is the country southward of the volcano and is devoid of vegetation. The **Great Crack,** on the western side of the lava flow of 1823 from Mauna Loa, marks the western limits of the desert. The Great Crack, which is visible from seaward, passes along the eastern side of **Puula Hill,** which is 1½ miles inland and 994 feet (303 m) high. A sharply defined, low, black cone is located about 5 miles inland and on the easterly side of the lava flow of 1823 at an elevation of about 1,800 feet (549 m).

Pahala mill, about 4 miles northward of Punaluu and 3 miles from the coast, is white and has two tall, white stacks. It is lighted at night, and is a good mark both by day and night.

The country between the Great Crack and Punaluu is covered with sugarcane to an elevation of about 2,000 feet (610 m); beyond this it is wooded up the mountain side to within about 6,000 feet (1,829 m) of its summit. Here and there bare lava flows cut up the cane fields. Cane in the Kau district extends as far westward as Waiohinu.

Punaluu Harbor (chart 4162) was formerly the shipping point for Pahala, but the landing is no longer used and the sugar of the district is now shipped from Honuapo. Small boats find some protection in from 6 to 11 feet (1.8 to 3.4 m) close to the eastern shore of the small bight which forms the harbor. The landing, which is at the head of the bight, is marked by the ruins of a warehouse. A prominent yellow church with green steeple is situated ¼ mile southwest of the landing and about ⅛ mile inland. The southwestern part of the bight is foul. A rock, awash at half tide, lies 240 yards 157° true (SE. by S. mag.) from the landing; another, with 8 feet (2.4 m) of water over it, lies 40 yards farther offshore on the same bearing. The entrance is between these rocks and the shore to the northward. A rock with 3 feet (0.9 m) over it lies ⅛ mile east of the entrance and 80 yards offshore. The northeast trades tend to haul more offshore here, but in rough weather breakers extend completely across the entrance and passage is then impossible. The church and houses of **Hilea,** 1¾ miles west of Punaluu and 1½ miles inland, can be seen from seaward. Back of the landing up to an elevation of about 3,500 feet (1,067 m) the slopes are broken; above this they appear regular and gradual to the summit of Mauna Loa. The upper slopes of Mauna Loa can only be seen from several miles offshore.

Enuhe (worm) **Butte,** 3 miles northwestward of Punaluu, is the seaward end of **Enuhe Ridge** and is a conspicuous flat-topped cone having an elevation of 2,327 feet (709 m). Iholena Butte, Pakua Butte, and Makanao Butte are promontories of Iholena Ridge, which extends for 3 miles northwest from the village of Hilea. **Ninole Gulch** lies between the two ridges, making the region extremely rugged with the buttes standing out boldly. The buttes are prominent from either the southwestward or northeastward.

Kaumaikeohu Peak, about 5 miles northward of Punaluu, is a prominent cone 3,430 feet (1,045 m) high, situated on the southeast boundary of the Kau Forest Reserve.

Honuapo Harbor (chart 4162), 4½ miles southwestward of Punaluu, is a slight indentation in the coast line and is marked by a wharf 200 feet (61 m) long with two large molasses tanks near

its inshore end. The most prominent landmark from offshore is a cliff 236 feet (72 m) high and ½ mile southwest of the wharf. Its upper half shows black against the light-brown background of the hills, and the lower half is a grass-covered slide. There are two churches—one (without steeple) 100 yards northwest of the wharf; the other (with steeple) about 300 yards northward of the wharf. The stack and white buildings of the sugar mill, ⅜ mile northward of the landing, are prominent, as are the five silver-colored tanks of the Standard Oil Co., 150 yards north of the wharf. A fixed red light, maintained by private interests, is shown on steamer nights only. It is located 185 yards northeastward from the inshore end of the wharf, at the northeast corner of the Standard Oil building.

The wharf, which is owned by the Territory and managed by a private concern, has 23 feet (7 m) at the outer end. Ships do not tie up to the wharf but drop both anchors ¼ mile to the southeastward of it, the port in about 10 fathoms (18.3 m) and the starboard in about 19 fathoms (35 m). Lines are run out to the wharf and to mooring buoys, and the ship lies heading 140° true (SE. ½ E. mag) with the wharf astern; the stern of the ship is then about 225 yards from the end of the wharf in about 10 fathoms (18.3 m). Freight is handled with lighters.

There is a local pilot whose services may be obtained by wire from Hilo. Fees for pilot service are dependent on tonnage. There is a charge of $15 for tying up and casting off. Stevedores are available. Both interisland and ocean-going steamers make regular calls here.

If entering for anchorage only, head for the Standard Oil building (or the fixed red light), steering 335° true (NW. ¾ N. mag) and anchor in 18 fathoms (33 m).

Some of the slopes back of Honuapo are covered with cane. Between Punaluu and Honuapo the shore is composed of masses of black lava rock, which project out into deep water. There are two conspicuous lava flows which run down to the beach northeastward of Honuapo, one about 1½ miles and the larger one 4 miles from the landing.

The villages of **Naalehu** and **Waiohinu** are situated on the southern side and at the base of **Kapuna Mountain,** which is 2,109 feet (643 m) high and 2¾ miles westward of Honuapo Harbor. The country between these villages and South Cape is a grassy plain on which cattle range.

Maniania Pali, which begins at Kimo Point, 2 miles south of Honuapo, and ends at Waikapuna Bay, is a black cliff with a band of yellow clay on top. It is from 100 to 200 feet (30 to 61 m) high. From here to Kamilo Point the coast is low and rocky.

Kamilo Point, about 8 miles southwestward of Honuapo, is a low, dark lava mass, on which is a black lava monument with a square base, surmounted by a dome. A reef, over which the sea generally breaks, extends about ¼ mile off the point. The shore on both sides of the point is strewn with driftwood, and there are a few abandoned sheds.

Kaalualu Bay, about 1 mile westward of Kamilo Point, affords good shelter for small craft during northeast trades, but is exposed during kona weather. With the easterly entrance point bearing 90° true (E. by N. mag.), distant about 200 yards, anchorage may be had

in about 10 fathoms (18.3 m). Between the anchorage and the cattle chute, which is in the northeast part of the bay, are several submerged coral reefs, which should be avoided, especially when there is a heavy swell. There is a green house with white roof and a cattle shed on the beach on the west side of the bay. Between Kaalualu and the South Cape the grassy plain is occasionally broken by bare lava spots. Two miles southwestward of Kaalualu the low coast line is broken by a 284-foot (87 m) grayish cinder cone.

Kalae (South Cape), 5 miles southwestward of Kaaluala Bay, a low, grass-covered point, is marked by a group flashing white light. The southeasterly shore is low, while the shore on the westerly side begins with a low bluff at the point and rises gently for a distance of 2 miles to the northward to a height of 335 feet (102 m), where it leaves the shore and trends inland for several miles, increasing in height and forming the **Mamalu Pali,** a remarkable cliff when seen from the westward. There is a wind-power generator on a skeleton tower near the light. Shoal water extends for ½ mile south of the point, and all vessels should keep 1 mile off to avoid possible dangers. On account of the shore current, which sometimes sets northeastward against the trade winds, it is generally rough on the easterly side of the cape. Offshore the current sets southwestward. There is an emergency airplane landing field on the point, near the light.

WEST COAST OF HAWAII (CHART 4115)

From Kalae (South Cape) to Upolu Point, a distance of about 98 miles, the coast has a general northerly trend. It is only partially surveyed, but is generally bold. The largest outlying reef, about ½ mile wide, is in Kawaihae Bay. At Kawili Point and Kumukehu Point, 3½ and 7½ miles northward of Keahole Point, shoal water extends about ½ mile offshore; otherwise, off the numerous capes and points the reefs do not make out over ¼ mile, and all dangers may be avoided by giving the coast a berth of about 1 mile.

There are no harbors or anchorages on this coast that afford shelter during all winds, although they are all smooth during the regular northeast trades, but exposed during kona weather. The trade winds draw around Kalae and hold northward offshore for about 3 miles, generally causing a rough sea. Close inshore the sea is generally smooth.

That section of the coast which lies between Kalae and Kawaihae Bay, 75 miles northward, is known as the **Kona coast.** The country along this coast is broken up by numerous lava flows, varying in length from a few hundred yards to 30 miles, that have broken out from Mauna Loa and Mount Hualalai and carried destruction with them on their way to the sea. Between these flows there are sections of country which are heavily wooded and covered with vegetation above an elevation of 1,500 feet (457 m), and there are large areas under cultivation. Many of the lava flows reach the coast and terminate in bluffs, some fairly high and others only a few feet above the water. Scattered trees and bushes will be seen between many of the flows.

From a point 2 miles northward of Kalae, where Mamalu Pali turns inland toward Mount Akihi, to Hanamalo Point there is a

low plain several miles wide, which rises gradually to the mountains. Here the country is extremely desolate, with its grayish-black slopes of bare lava. A particularly black flow lies at the base of the lighter-colored cliffs of Mamalu Pali.

At an elevation of 2,000 feet (610 m) the kona region is known for its cool and bracing climate, and rain is plentiful. Little variation in weather conditions is experienced, there generally being a land and sea breeze, except during kona winds. This condition, however, does not apply between Kawaihae Bay and Upolu Point, since it is affected by the winds which draw across the island.

Waiahuakini, 2 miles north of Kalae, is a small fishing village at the base of the cliffs. It is marked by a small patch of white sand. **Kailikii Shoal** extends for a considerable distance offshore to the west and north of the landing. **Puuhou** (Marchant Hill), is a black, well-defined cone 273 feet (83 m) high, situated on the shore 1½ miles northwestward of Waiahuakini.

Pohue Bay, 9 miles northwest of Kalae, has a sand beach at its head where landing can be made.

Pele Hills are a group of cones near the beach 12 miles northwestward of Kalae. These cones are prominent landmarks, and at the summit of the highest one is a black stone pyramid.

Kauna Point, 2 miles northwestward of Pele Hills, is low, flat, and somewhat grassy, with a small hummock of grayish lava ½ mile inland.

Kaulanamauna, 4 miles northwest of Pele Hills, affords a landing place. There is a house here, uninhabited.

Kapua Bay, 1 mile south of Hanamalo Point, is a shipping point for cattle. The local steamer calls occasionally. The usual anchorage is about 350 yards off the houses on the beach. The cattle are brought out through the surf and boated to the ship.

Okoe Landing is situated on Okoe Bay immediately south of Hanamalo Point. The cove indents the shore more than any other in the vicinity and shows a little more sand on the beach. Anchorage can be had in 7 to 15 fathoms (12.8 to 27.4 m).

Hanamalo Point, about 22 miles northwestward of Kalae, is a low mass of lava, and on account of having no characteristic features is difficult to distinguish from other points in the vicinity unless close inshore. The current divides at this point, one part following the coast around Kalae and thence northeastward along the shore, losing its strength in the vicinity of Keauhou. North of Hanamalo Point the current sets northward, and vessels have been known to drift between 1 and 2 miles an hour during calms.

Milolii Village, 2 miles northward of Hanamalo Point, is marked by a substantial concrete boat landing with derrick and shed. The landing, which has 7 feet (2.1 m) of water, is the property of the Territory and is under the charge of a wharfinger. About 40 yards northward of the landing are two white cairns of rock with poles which mark the range for steamers to enter. Upon whistle signals from ships, lighted lanterns are hung on the range poles at night. The local steamer anchors on range in from 25 to 40 fathoms (46 to 78 m) and boats the freight to the landing. It is a shipping point for koa wood, which comes from the higher slopes of Mauna Loa. There is a prevailing northerly set which sometimes reaches a ve-

locity of 2 knots. There is a yellow schoolhouse in the ironwood grove 250 yards southward of the landing, which is visible from the northwestward only. Between the school and the landing is a grove of coconut trees, back of which are the 15 or 20 houses of the village. Otherwise the countryside is a barren mass of lava. There is good anchorage for small boats.

The lava flow of 1926 from the slopes of **Mount Keokeo** entirely wiped out the village of Hoopuloa, 1 mile northward of Milolii. The same flow nearly took Milolii also. About 3 miles north of Milolii the black flow of 1919 is prominent.

Lepeomoa Rock, 9½ miles northward of Milolii, is located at the water's edge; it is the rim of an old crater and is crescent shaped, with its seaward face blown out. The rock is about 100 feet (30 m) high. One mile inland from the rock the 1,766-foot (538 m) peak of **Haleili** may be seen. There are small villages of a few houses each scattered along the coast, a mile or two apart, between Milolii and Lepeomoa Rock. The highway, which is 2 miles inland at Milolii, draws nearer the coast until at Lepeomoa Rock it is ½ mile inland.

Kauhako Bay, about 2½ miles northward of Lepeomoa Rock, is marked at its head by a pali, or cliff, which is about ½ mile long and about 120 feet (37 m) high. The bay is a slight indentation in the coast, and the village of **Hookena** is located on the lowland in front of the northerly end of the pali. A stone church with steeple is a prominent landmark in the northerly end of the village. There is a large grove of coconut and shade trees near the village. Anchorage can be found in 15 fathoms (27.4 m), sandy bottom, about 300 yards off the village. There is a landing near the north end of the sand beach. It has been discontinued as a regular port of call, but steamers load cattle here occasionally. The bluffs along the coast lose their height north of Hookena. The slope up to the interior is not as steep as to the southward, and the country is covered with plantations. Coffee is the principal product.

Loa Point, about 1 mile north of Hookena, is flat and low, green to within 40 yards of the water, and then rocky. Between Loa Point and Hookena is the settlement of **Kealia**, at the north end of a long pebble beach. A characteristic of the villages of this section of the coast is that they consist of a few houses on the beach, with the post offices and greater portion of houses located on the highway, 1 or 2 miles inland.

Honaunau Bay (chart 4123), 3 miles northward of Kauhako Bay, indents the coast about 500 yards and is about the same width. It lies between two flat lava points; the southerly one **(Puuhonua Point)** is lower and smaller, and is marked by the 12-foot (3.7 m) high stone walls of the **City of Refuge**, as well as a grove of tall coconut trees. The City of Refuge is of historical interest and is now maintained as a county park. In former times criminals or refugees reaching the place were safe until such a time as the king of the land took action. Sampans anchor in from 4 to 8 fathoms (7.3 to 14.6 m) 150 yards north of the south shore, and ships' boats can make easy landings on the shingle beach in the southeastern side of the bay during normal weather. About 1½ miles inland on the slopes are two or three large, abandoned tobacco warehouses.

Palemano Point, on the south side of the entrance to Kealakekua Bay, is low and flat with scattered coconut trees and temple ruins near its end. A mass of bare rocks extends off its north side for 125 yards. About 3/8 mile northward of the point an old lava flow makes down to the beach; this flow is about 3/8 mile wide.

Kealakekua Bay (chart 4123), 3 miles northward of Honaunau Bay, is marked on its northerly side by a flashing white light on **Cook Point.** It is about 2 miles wide between Keawekaheka Point and Palemano Point and indents the coast about 1 mile. It is free of obstructions, affords good anchorage in all but strong southwesterly winds, and is by far the best anchorage on this coast. A narrow reef fringes the shore between the southerly end of the cliff and Palemano Point. The shore of the bay is low, except on the northeast side, where there is a precipitous cliff between 400 and 600 feet (122 and 183 m) high and about 1/2 mile long. **Kaawaloa Cove** is the northerly part of the bay and lies between the high cliff and Cook Point. It was here in 1779 that Capt. James Cook, R.N., was killed by the natives. Cook's Monument is a concrete shaft, 25 feet (7.6 m) high, located near the shore on the inner side of Cook Point. A concrete landing with about 6 feet (1.8 m) of water affords a means for visitors from passenger steamers to reach the monument.

The village of **Napoopoo** consists of a few houses scattered among the coconut trees just southward of the cliff. Provisions can be obtained in limited quantities; fresh water is scarce. Gasoline and some ship chandlery may be obtained. The landing, which has about 4 feet (1.2 m) of water, is in the middle of the village alongside of a low shed; during a heavy swell it is best to land on the sand beach at the north end of the village. The local steamer makes regular calls here, the principal export being coffee. Some cattle are shipped from the cattle chute near Cook's Monument. There is a post office here, and telephone communication with other parts of the island is available. A white church with spire is fairly prominent from offshore.

Approaching Kealakekua Bay from either direction a vessel will be enabled to pick it up by heading for the dome of Mauna Loa on the bearing 90° true (E. by N. mag.); a 33° true (NNE. mag.) course, heading for the middle of the cliff, will lead into the bay. Good anchorage can be found in 12 to 18 fathoms (21.9 to 33 m), with the south end of the cliff bearing 55° true (NE. 1/8 N. mag.) and Cook's Monument bearing 314° true (NW. by W. 1/8 W. mag.). In choosing an anchorage it is well to remember that there is a sea breeze in the daytime, shifting to a land breeze at night. The bottom is of coral and sand and is only fair holding ground.

Keawekaheka Point, on the north side at the entrance to Kealakekua Bay, is a low, bare, lava point. An extensive lava flow reaches from the point to the high cliff in the bay.

Puu Ohau is a green cone 231 feet (70 m) high, located near the beach, about 1 1/2 miles northward of Keawekaheka Point; it has a blowhole in the middle and its seaward side is blown out, forming a red cliff.

Keikiwaha Point, 2 1/4 miles northward of Keawekaheka Point, is low, black, and jagged, with coconut trees on it. Two miles inland from the point and on the main road an electric plant with stack was

under construction in 1932. Just north of the electric plant the red-roofed church and other buildings of Kainaliu may be seen.

From Napoopoo to Kailua, the most thickly settled section of the coast, cultivated fields of coffee extend both ways from the highway, which parallels the shore 1 to 2 miles inland.

Keauhou Bay (chart 4163), 2½ miles northward of Keikiwaha Point, indents the coast ¼ mile and is 300 yards wide between the entrance points. It lies between two lava flows at the foot of a gentle slope. Scattered coconut trees and a few buildings are close to the rock and sand shore at the head of the bay. The Keauhou yellow schoolhouse, located on the highway 1½ miles inland, is fairly prominent from offshore. The bottom is extremely irregular and has many coral heads with 5 or 6 feet (1.5 or 1.8 m) of water over them. A reef extends ⅛ mile off the north entrance point of the bay, and boats should favor the south entrance point when entering. By keeping a lookout for coral heads, boats of 4-foot (1.2 m) draft can enter the bay for anchorage, with the chart as a guide. Frequently breakers extend across the mouth of the bay. **Kahaluu** is a small village about 1 mile northward of Keauhou.

Mount Hualalai, in the central western part of Hawaii, is a conical peak, 8,269 feet (2,520 m) high, covered with vegetation to its summit, and is prominent from any point of approach. Its western slopes terminate in a bare, lava plain about 4 miles wide, which forms a low beach consisting of sand in some places and lava rock in others.

Kailua Bay (chart 4164), 5 miles northward of Keauhou Bay, is marked on its northerly side by a flashing white light. It is a small indentation in the coast at the southerly end of the flat plain that extends northwestward to Kawaihae Bay. The bay affords good anchorage except during kona weather. The landing is on the northerly side of the bay at a wharf having from 3 to 5 feet (0.9 to 1.5 m) of water along its eastern side. The shed of the wharf and the two oil tanks 130 yards westward are prominent. A prominent church with red roof surmounted by a tower with red steeple stands about 100 yards from shore and 350 yards due east of the wharf. Kona Inn, a long grayish building, is situated near the beach on the eastern side of the bay.

Kailua Village is situated along the shore of the bay and next to Hilo, is the most important town on the island. It is a well-known base for sportsmen engaged in trolling for swordfish and sailfish, for which the Kona coast is famous. Provisions and water can be obtained in limited quantities, as well as gasoline and some ship chandlery. Fishing launches are available for hire. Both passenger and freight steamers make regular calls here, the principal exports being coffee and cattle. Cotton is raised to some extent. There is a paved highway to the main road at Holualoa.

Approaching from seaward, steer for Mount Hualalai on a 66° true (NE. ⅞ E. mag.) course; the town will be ahead and will be recognized by the red roofs on the houses which stand out conspicuously against the green background. When off the entrance to the bay, head for the red-roofed church previously mentioned, on a 33° true (NNE. mag.) course and anchor in 10 fathoms (18.3 m),

sandy bottom. Passengers and freight are landed at the wharf from ship's boats. Steamers calling for cattle anchor farther in the bay and run out a stern line to the mooring buoy 150 yards southward of the wharf.

A small group of rocks, bare at times, is situated 230 yards offshore and 5/8 mile southeastward of Kailua wharf.

Kaiwi Point, 2 miles northwestward of Kailua, is low and black, with some small patches of white sand showing. Shoal water extends about 1/4 mile offshore on the south side of the point, while on the west side the 100-fathom (183 m) curve lies 1/4 mile off.

Keahole Point, 7 miles northwestward of Kailua, is the westernmost point of Hawaii. It is marked by a group-flashing white light, with a red sector marking the rocks and reefs lying off Makolea and Kaiwi Points. The point is prominent, low, and well-defined, and consists of black lava with some small vegetation. White patches of sand may be seen here and there between the fingers of lava. Frequently there are small tide rips a short distance off the point. A berth of 1/2 mile clears the point in deep water.

Mount Waawaa, 13 miles eastward of the point, is prominent, 3,824 feet (1,166 m) high, and can often be seen when Mount Hualalai is hidden by the clouds. It is dome-shaped, with deep gorges in its sides, and rises about 1,000 feet (305 m) above the slope on which it stands.

Between **Makolea** and **Kawili Points,** 3 and 4 miles northward of Keahole Point, shoal water extends about 1 mile offshore, where bottom of sand and coral is plainly visible. When a heavy swell is running, breakers extend about 1/2 mile offshore. Strangers should give these points a berth of 1 1/2 miles. **Mahaiula Village** is situated on the unimportant bay between the two points. Between Keahole Point and Mano Point there are several small bays, which are rarely used.

Kuili Hill, 5 miles northward of Keahole Point and 1/4 mile inland, is a brown crater 346 feet (105 m) high, which marks the seaward end of a series of blowholes, or cones, that are on the ridge on the northwesterly slope of Mount Hualalai. Two miles northward of Kuili Hill and between the villages of Kukio and Kaupulehu an extensive shoal extends 1/2 mile offshore.

Mano Point, 9 miles northeastward of Keahole Point, is rounded, not well defined, and consists of a flat mass of lava.

The coast between Kailua Bay and Kawaihae Bay is a black jagged mass of lava, with numerous capes and indentions made up by numerous lava flows over the level country. The lava flow of 1859, which reaches the sea south of Kawaihae Bay, marks the northern limits of the lava flows. Between Keahole Point and Upolu Point the trade winds draw over the mountains, at times causing a very strong offshore wind. Vessels that anchor in this vicinity should be prepared to use both anchors, as the prevailing northerly current prevents laying to the wind.

Kiholo Bay, 11 miles northeastward of Keahole Point, indents the coast 1/2 mile and is 1 mile wide. The eastern side of the bay is foul, but local steamers anchor close up to the cattle chute on the black lava shore on the west side of the bay. **Kiholo village** con-

sists of a few houses in a coconut grove in the northeast corner of the bay. The local steamer calls several times a year for cattle.

Anahulu Hill, 4 miles east of Kiholo, is a prominent yellowish cone 1,523 feet (464 m) high, from which lava flows have poured.

Kapalaoa, a small village on the south side of a small bight 4 miles northeastward of Kiholo, is marked by a red-roofed house. The bight is foul and can only be used by small boats with local knowledge.

Puako Bay (chart 4165), 20 miles northeastward of Keahole Point, is a small indentation in the coast affording very little protection, and that to small boats only. It is open to westerly and northwesterly winds and is full of coral heads and reefs. The shores of the bay are, for the most part, made up of black, smooth lava running out into the water on a gentle slope with many detached rocks of the same material. A small wooden landing is situated in the southeast side of the bay, and several buildings are scattered along the south shore. Small boats making the landing have a clear passage holding the landing on 137° true (SE. ¾ E. mag.) until 250 yards from it; from here to the landing a lookout must be maintained to sight out the channel. Local steamers call occasionally for livestock and honey, but strangers should not attempt the bay without the aid of the chart. Anchorage can be had about ¾ mile northwest of Puako in from 12 to 15 fathoms (21.9 to 27.4 m), sand and coral bottom. The reef off Waima Point, 1 mile southwest of Puako, is easily recognized from a safe distance offshore. A conspicuous lone eucalyptus tree shows above the algaroba trees ¼ mile southwestward of the landing.

The coast line, which has a northeasterly trend to Puako, gradually recurves to the northwest, forming Kawaihae Bay. The black lava flows are no longer a characteristic of the coast, and the back country, with its extensive plains and slopes, forms some of the best grazing lands in the islands. The strong northerly current which is felt off Keahole and Makolea Points, and again off Mahukona, passes offshore of Kawaihae, where there is practically no current.

Kawaihae (chart 4166), 23 miles northeastward of Keahole Point, is a village in the northern part of the bay of the same name. It is marked by Kawaihae Light, 200 yards northward of the extensive reef which fringes the beach in front of the village. The light has a red sector which covers the northerly edge of the reef. Prominent features are **Honokoa Gulch,** the deep, heavily wooded mouth of which is about ½ mile northward of the village; the white pyramidal light tower; the galvanized-iron roof of the landing shed; two silver-colored oil tanks about 200 yards northward of landing, and a radio mast in the northern part of the village. **Kawaihae Heiau,** a square of dark rocks on a 50-foot (15.2 m) knoll ¾ mile southward of the village, can be seen against the green background.

The reef, which is ½ mile wide and 1½ miles long, is bare in places, and should be approached with caution, as the sea generally does not break over it during offshore winds. A landing, for small boats only, is situated about 25 yards northeastward of the northerly edge of the reef. The shore, which is rocky with stretches of sand beach, has a thick growth of algaroba trees. Local steamers call several times a month for cattle; they anchor about 200 yards westward of the landing and run stern lines inshore to mooring buoys.

Small boats seeking anchorage behind the reef head for the landing on an easterly course and, when close to the landing, pass through the narrow channel to southward to protected anchorage. In southwesterly weather there are breakers across the channel leading to the landing. Good anchorage, except during kona weather, can be had between the light and Honokoa Gulch, about 3/8 mile offshore and in 8 to 15 fathoms (14.6 to 27.4 m). Anchorage south of the landing is dangerous.

Approaching Kawaihae Anchorage from the northward, when within 2 miles of the beach, head for Kawaihae Light on a 90° true (E. by N. mag.) course and select anchorage as described in preceding paragraph; *from southward*, head for the mouth of the deep gulch 1/2 mile northward of the village on a 56° true (NE. mag.) course until Kawaihae Light bears 90° true (E. by N. mag.).

Kamalii Hill, 1 mile north of Kawaihae, is 670 feet (204 m) high and fairly conspicuous. Between Kawaihae and Mahukona the country is uncultivated grazing land and consists of mountain slopes which are cut here and there by ravines, and which terminate in cliffs at the coast. Deep water is close to the shore, and there are no known dangers.

Mahukona Harbor (chart 4101), 10 miles northward of Kawaihae, is an open bight marked on its southerly side by Mahukona Light and on its northerly side by Makaohule Point. Strong offshore winds, accompanied by violent gusts from varying directions, are frequently experienced during the normal northeast trades. The prevailing current is northerly, and at times approaches a strength of 2 knots. Because of these conditions, vessels should anchor with plenty of cable and have a second anchor ready to let go. If mooring to the buoys, use good lines of ample size. Several privately owned mooring buoys are maintained, the three bow buoys being 1/4 mile westward of the landing in about 10 fathoms (18.3 m), and the stern buoys close to the beach in about 3 fathoms (5.5 m).

Mahukona consists of a few houses located in an algaroba grove near the beach and is the terminus of a plantation railroad that goes around the northerly end of the island as far as Akokoa Point, affording transportation for the Kohala sugar district. Provisions, gasoline, and water for small boats can be obtained. There is a pilot who will meet vessels requesting his services. There are three privately owned, fixed red lights; two mark the range, 80° true (ENE. 1/8 E. mag.), leading to the bow mooring buoy and to the territorial landing, and the other is on the north point near the north landing. Both landings are for small boats and barges only. The territorial landing, at the head of the bight, is equipped with power and a surf line by means of which sugar barges are hauled to and from the vessels at the mooring buoys. Local and ocean-going steamers call here regularly.

Prominent features.—Two white beacons, each conical in shape and 15 feet (4.6 m) high, are good day marks, one on the southerly side of Makaohule Point 400 yards northward of the landing and one 400 yards southward of the landing and just northward of Mahukona Light. The white-roofed shed and the derrick at the landing, and the tall white flagpole 110 yards southward are prominent, as well as the white oil tanks and red-roofed warehouses on the

north side of the bight. The shore is rocky, and the slopes in back of the village are partially covered with algaroba trees.

Anchorage may be selected just northward of the outer buoys in from 10 to 15 fathoms (18.3 to 27.4 m), sand and coral bottom. The chart is the guide. An anchorage with less wind can be found ½ mile northward and about 400 yards off the railroad embankment.

Honoipu Anchorage, an open bight 4 miles northward of Mahukona, has been abandoned as a landing. An indifferent anchorage can be found in 8 to 10 fathoms (14.6 to 18.3 m) off the remains of the old wharf. The coast between Mahukona and Upolu Point is a series of low, black bluffs, back of which the country is marked by numerous old blowholes and rises gently to the Kohala Mountains. The cuts and fills of the plantation railroad, which skirt the coast from Mahukona to the village of Kohala, may be seen when close inshore.

Alenuihaha Channel lies between the islands of Hawaii and Maui and is 26 miles wide in its narrowest part between Upolu Point, Hawaii, and Kailio Point, Maui. It is free from obstructions and has bold water close to shore. During strong trade winds the channel is quite rough, and a current of from 1 to 2 knots sets westward; but during the calms that frequently follow there is at times an easterly set of about 1 knot, which during kona winds may reach a velocity of 2 or 3 knots. The channel is roughest and the westerly current strongest when the wind is between north-northeast and east-northeast. When the northeast trades are strong, violent tide rips may be encountered 2 miles north of Keahole Point, probably caused by the meeting of the southwesterly offshore current with the northerly inshore current, heretofore mentioned. When bound from Upolu Point for Alalakeiki Channel, an onshore set is sometimes felt when reaching the lee of Maui.

MAUI (CHART 4116)

the second in size of the islands, lies 26 miles northwestward of Hawaii. It is about 42 miles long in a westerly direction and about 23 miles wide, and consist of two distinct mountain masses joined by a low flat isthmus. The extinct crater of **Haleakala,** 10,032 feet (3,058 m) high, is near the center of the eastern peninsula. On the northwesterly side of the crater the land slopes gently, while on the southerly and easterly sides it is much steeper and in some places precipitous. **Koolau Gap** on the northerly side and **Kaupo Gap** on the southeasterly side are two large openings in the side of the crater.

Mount Kukui, 5,788 feet (1,764 m) high, is near the center of the western peninsula. This peninsula is cut up by rugged peaks and deep valleys and gulches, which open out in sloping plains that extend to the coast.

Population.—By the census of 1930, Maui had 48,756 inhabitants.

Winds.—The trade winds divide at Kauiki Head, part following the trend of the coast northwesterly as far as the isthmus when it again divides, part of it drawing southward, often reaching great force to the vicinity of Maalaea Bay. Another part follows the trend of the coast around the northwesterly end of Maui and through Pailolo Channel; the wind blows with greater force on the Molokai

side of the channel. From Kauiki Head the wind follows the trend of the south coast of Maui, part continuing along the south shore of Kahoolawe and part drawing through Alalakeiki Channel around the northerly end of Kahoolawe and westward through Kealaikahiki Channel. On the south coast of Maui a sea breeze frequently sets in about 9 a.m. and continues until after sundown, when the land breeze springs up. Light airs or calms are generally found in the vicinity of Molokini, and again along the west shore of Maui between Hekili and Kekaa Points. In the vicinity of Lahaina there is generally a light onshore breeze, while farther out in Auau Channel the northeast trades are felt.

Rainfall.—There is quite a heavy rainfall on the weather side, while on the lee side it is very light.

Anchorages are numerous on the southwesterly side of Maui, the first requirement under ordinary conditions being shelter from the trade winds.

Supplies.—Provisions, water, ice, lumber, coal, fuel oil, gasoline, and some ship chandler's stores can be obtained at Kahului. Gasoline and some provisions can be obtained at other places.

Repairs.—There is a machine shop at Kahului where minor repairs can be made. There are no dry docks.

Communication, both by steamer and airplane, is frequent between Maui and the other large islands. There is communication by telephone to all parts of the island and by radiotelephone to the other islands and to the mainland of the United States.

Currents.—In general, the currents are greatly influenced by the trades, although on account of the positions of the several islands the prevailing direction is against the wind in certain channels. A current follows the north shore of Maui westward from Kauiki Head, and a strong current follows the coast southward of Kauiki Head until past Kahoolawe, where it turns northwestward. In the middle of Auau Channel the current sets northerly, but in the vicinity of Lahaina it flows north on the ebb and south on the flood. The prevailing current in the middle of Kalohi Channel is easterly, although it is westerly for a short period at the time of the lower high waters.

Hana Bay (chart 4113) is situated at the easterly end of Maui and is marked on its southerly entrance point by Kauiki Head Light, and on its northerly side by Nanualele Point. The bay is ⅜ mile in diameter and is open to the eastward. There is a concrete wharf, 80 yards long and marked by a shed, on the south side of the bay. The wharf has depths of 21 to 26 feet (6.4 to 7.9 m) alongside. The local steamer, as well as some ocean-going steamers, makes regular calls here.

Sugar and cattle are the principal exports. Gasoline and provisions can be obtained here. The bay does not afford a desirable anchorage. Small vessels sometimes anchor in the southwest portion of the bay, but do not have much swinging room. They are exposed to northeast winds and sea, and during strong southwesterly blows the wind comes offshore in such heavy squalls that they are apt to drag anchor. In the absence of local knowledge this anchorage should not be attempted by any but small craft. An anchorage can be had in deeper water along the coast between Kauiki Head and Alahu Island.

The shore of the bay is rocky except for two short gravel beaches, one at the south end of the bay and the other on the northwesterly side. A shoal, usually marked by breakers, extends halfway across the bay from the middle of the north shore. A small rocky shoal, with 16 feet (4.9 m) of water over it, lies 370 yards north of the light. This shoal is marked on its southerly side by a red nun buoy. The entrance channel lies between the buoy and Twin Rocks. There is an unlighted entrance range (each beacon a pole with two white diamond-shaped marks); course on range, 239° true (SW. ¼ W. mag.). Vessels drop anchor northeastward of the wharf, make a starboard landing, and run bow and stern lines to mooring buoys off the wharf. There is a wharfinger.

There are no hotels in the village, but lodgings may be obtained in private homes. A conspicuous, abandoned cannery building and stack is situated ⅜ mile west of Nanualele Point. The sugar mill and stack, with many red-roofed cottages near by, is situated on the low ridge ½ mile southwestward of the wharf. The mill and buildings are plainly seen from the southeastward. The lights of the mill settlement are a good mark at night, but they are not seen from the direction of Kauiki Head.

Nanualele Point is the low, flat, lava point on the north side of Hana Bay. Many rocks, some bare at all tides, extend for 200 yards off the point.

Kahaula Cone, 545 feet (166 m) high, is the highest of a group of 5 hills lying ¾ mile westward of the landing. The land near the coast is covered with cane for a distance of about 4 miles on each side of the mill.

Kauiki Head, the easternmost point of Maui, is an extinct crater 390 feet (119 m) high, the outer half of which has been eroded, leaving the inside of the crater exposed. It is dark brown in color, is joined to the mainland by a comparatively low neck of land, and from a distance appears as an island. Close to the northerly side of Kauiki Head is an islet on which is located **Kauiki Head Light.** Two black rocks and a rock awash lie near the northwesterly side of the islet.

Twin Rocks are two bare rocks with deep water close-to, lying about 300 yards northeastward of the light; the inner rock is the larger and is 15 feet (4.6 m) high.

Inner Pinnacle Rock, about 3 feet (0.9 m) high, lies 200 yards southward of Outer Twin Rock. **Outer Pinnacle Rock,** about 5 feet (1.5 m) high, lies 300 yards southeastward of Outer Twin Rock.

The coast between Kauiki Head and Nuu Anchorage consists of high, rough bluffs, broken up by numerous small capes and indentations, and is covered with vegetation as far as Kaupo Gap. The entire south face of Haleakala is steep and eroded and presents a reddish-brown appearance, dotted here and there with green patches. The slopes become less steep as the shore is approached.

Alau Island, 1½ miles south of Kauiki Head and about ⅜ mile offshore, is about 100 yards in diameter and 150 feet (46 m) high and is grass covered. Between the island and the mainland there is an extensive reef. **Danger;** two rocks, with about 9 feet (2.7 m) of water over them, lie close together, about ¾ mile southeastward

of Alau Island. Under favorable conditions these rocks appear as small, yellowish-brown spots in the water. However, they are seldom seen and they do not break in moderate seas. Vessels should avoid them by giving Alau Island a berth of about 1½ miles in passing.

Iwiopele, about 1½ miles south of Hana Bay, is a formation very much like Kauiki Head and resembles it in size and appearance.

Mokae Cove, almost 1 mile south of Iwiopele, affords a landing for small boats in northeast weather. A large white church, with green roof and spire, is located on the bluff in the vicinity of Puuiki, about 1 mile southward of Mokae Cove. From Makaalae Point, ¾ mile south of Mokae, the coast has a southwesterly trend. Between Mokae and Wailua there are several small villages close to the shore.

Wailua Cove, about 3½ miles southwest from Mokae Cove, is at the mouth of a valley that is marked by a large, white cross erected on a small hill a short distance up the valley. This cross is only visible over a small arc directly off the valley. Inland from the cove and halfway up the mountain slope, a high waterfall is usually conspicuous from offshore. Landings may be made during normal trade-wind weather in almost any of the coves along this coast, although the swell comes in to all of them. **Muolea Point,** 1 mile eastward of Wailua Cove, is well rounded and rocky.

Kipahulu, 2½ miles southwest from Wailua Cove and ½ mile westward of Puhilele Point, is a plantation settlement marked by a mill with a prominent concrete stack. The village is on the western side of the deep valley of the same name. The two landings on the shore below the village are no longer used, as freight is transported to Hana by truck. A red church with spire is situated about ½ mile eastward of the mill and about the same distance inland. A white church, which is partly hidden by trees from the southwestward, is situated between the mill and the shore. The village marks the western limits of cane fields. **Ahole Rock** lies about ¼ mile offshore. It is low, flat, and bare in appearance. There is a poor anchorage here, exposed to the swell. It is not recommended.

Kaapahu Bay, about 1½ miles west of Kipahulu, is a slight indentation in the coast that sometimes can be used as an anchorage by small boats in trade-wind weather. Anchor in 4 fathoms (7.3 m) about 200 yards off the pebble beach.

Kaupo Landing, about 1½ miles west of Kaapahu Bay, is the best landing place in the vicinity during trade-wind weather. The local steamer visits this place occasionally, handling general cargo. The region is divided into small homesteads and cattle raising is the principal occupation. The landing, which is on the eastern side of the village, has a derrick on a platform cut in the easterly side of the rocky bluff. Vessels anchor well off, and a little east of, the derrick and run a surf line to the landing. Freight is boated to the landing and hoisted to the platform by the ship's winches and surf line. When the wind is east and strong, landing is difficult. About ¼ mile westward of the landing and near the beach is a conspicuous white church with green roof.

Kailio Point, 2 miles southwest of Kaupo Landing, is a narrow point 73 feet (22 m) high, marking the east end of **Mamalu Bay.** An anchorage can be found here in trade-wind weather about 300

yards offshore from the head of the bay in 10 fathoms (18.3 m), sandy bottom.

Kaupo Gap is the large opening, 1¼ miles wide, in the southeastern side of Haleakala Crater, from which an immense old lava flow extends to the coast on a gradual slope. The Kaupo lava flow is brush covered, and the wide, U-shaped gap at the top is a good day or night landmark from the vicinity of Kailio Point. The lava flow forms a marked dividing line between the barren western part and the forest and brush-covered eastern part of the south coast. Waterfalls are numerous east of the gap.

Apole Point, 2 miles westward of Kailio Point, is low and is composed of black, jagged rock. It marks the seaward end of Kaupo lava flow.

Nuu Anchorage, 2¼ miles westward of Kailio Point and immediately westward of Apole Point, is a small bight formerly used as a shipping point for cattle. There are a few scattered sheds and a corral, none of which are conspicuous. Small vessels can find anchorage in about 8 fathoms (14.6 m), sandy bottom.

From Nuu to **Pohakueaea Point,** 11½ miles to the westward, the coast is barren, with deep water close up. All dangers are close to the bluffs. At Pohakueaea Point the 20-fathom (37 m) curve begins to trend offshore. A few homesteads may be seen on the slopes that rise to the rim of Haleakala. The slopes are cut up by gulches and are barren except for a scattering of trees about half way up.

Danger.—A pinnacle rock with less than 12 feet (3.7 m) over it is said to exist somewhere between Pohakueaea Point and Keoneoio Bay, within ½ mile of shore. It may be off Pohakueaea Point as an extension of the lava flow that forms the point. Vessels making the run along this coast in recent years have observed no indication of an offshore danger; however they do give Cape Kinau a berth of about 1 mile, as it is known that a steamer struck bottom in the vicinity of the cape, probably about ¼ mile offshore (see paragraph on Cape Kinau).

Lualailua Mountains, 7 miles westward of Nuu Anchorage and 2 miles inland, are a group of red mounds about 2,000 feet (610 m) high.

Hokukano Cone, 1 mile west-southwestward of Lualailua Mountains, is a conspicuous red cone with a lava flow which reaches the sea in a high black mass.

Pimoe Dome, 2¼ miles westward of Hokukano Cone, is red and irregular, with its easterly side broken; it is the crater from which the large fan-shaped lava flow in the vicinity of Pohakueaea Point had its origin.

Cape Hanamanioa, the southwesterly end of the island, is a black lava mass, marked by a group flashing white light.

Keoneoio (La Perouse) Bay, lies between Cape Hanamanioa and Cape Kinau. It is about ½ mile wide and indents the coast about ½ mile and is marked on its northwest side, at the water's edge, by **Kanaloa Crater,** a low, yellowish-brown cone with its seaward side blown out. This crater is surrounded by a lava flow which has come down from **Lapa Crater,** a small black cone about 1 mile northward of the bay. There is a small settlement at the foot of Kanaloa

Crater. There is a rock with 10 feet (3 m) over it in the middle of the entrance to the bay, and the bottom is rocky; it is not recommended for strangers. There are no harbors or anchorages between Nuu Anchorage and Keoneoio Bay, and the country back of this section of the coast is bare, with practically no signs of habitation.

Cape Kinau is on the northerly side of Keoneoio Bay and is a broad, low, black lava point. A rock with 4½ feet (1.4 m) over it lies 400 yards offshore near the northerly end of the cape.

Olai Hill, 2¼ miles northward of Kanahena Point, is the most prominent landmark in this vicinity. It is brown in color, 367 feet (112 m) high, and consists of three bare knolls, the southernmost being the highest.

Molokini, marked by a flashing white light, lies 2¾ miles 263° true (WSW. ⅜ W. mag.) from Olai Hill, and is a small, crescent-shaped islet about ¼ mile long and 156 feet (48 m) high. It is the bare southern rim of an extinct crater, the northern part of which is submerged. A reef makes off about 300 yards northward from the northwesterly end of the islet. There is deep water close to the southern side of the islet. The light structure, a white skeleton tower 31 feet (9.4 m) high, is on the high, southerly side. Vessels pass the islet on either side.

Makena Anchorage, 1 mile northward of Olai Hill, is exposed to kona weather, but affords good holding ground during the trades in about 12 fathoms (21.9 m) ⅜ mile off the point, with the boat landing bearing 85° true (ENE. ⅝ E. mag.) and Olai Hill bearing 169° true (SSE. mag.). The boat landing, which is no more than a bulkhead along the side of a small slip, is in the northeast side of the bight, on the southerly side of the most prominent point in the vicinity. Anchorage can also be had in **Ahihi Bay,** just south of Olai Hill. A few houses may be seen among the algaroba trees on the rocky point forming the north side of the bight, and another prominent house is situated at the southerly end of the white sand beach. The red spire of a small church and the red roof of the school show above the algaroba trees. The strong trade winds which are felt in Maalaca Bay are not pronounced off Makena. The anchorage was formerly used as a shipping point for cattle, but steamers no longer call here. There are no stores at Makena, but roads lead northward, southward, and eastward from the village.

The country back of Makena rises gently to the mountains; the lower slopes are covered with cactus, while higher up it is wooded in places. From Makena to Kihei the coast has a general northerly trend; it is low and thickly covered with algaroba trees. The country back of this section of the coast is the same as that in the vicinity of Makena. High up the slopes are small pineapple fields; otherwise the land is not cultivated.

Keawakapu, 4 miles north of Olai Hill, is marked by an old wharf extending offshore in a southwesterly direction, and is used by small boats only.

Maalaea Bay (chart 4104) is the large bight in the middle of the southwest coast of Maui; its shores are low and for the most part sandy and lined with algaroba trees. The isthmus and the slopes on either side are covered with sugar cane and other vegetation. The bottom is very irregular in the central and eastern portions of the

bay. On account of the fresh winds that sweep across the isthmus during the trade winds and the fresh southerly winds during the konas, the bay is a poor anchorage. A reef fringes the shore for a distance of about 3½ miles southward of Kihei. Off Kalepolepo, where the reef is widest, there is a 14-foot (4.3 m) spot at its outer end, lying ½ mile from shore. Strangers should pass well offshore. Broken ground, with a least depth of 3 fathoms (5.5 m), lies about ¾ mile west-southwestward of Kihei wharf. A shoal with a least depth of 7 fathoms (12.8 m) lies in the center of the bay.

Kalepolepo, on the eastern side of Maalaea Bay, is marked by a large building on the shore, and an old, large fish pond which extends nearly ¼ mile from the shore. Sampans with local knowledge find anchorage in shallow water in back of the reef.

Kihei Anchorage, in the northeastern part of Maalaea Bay, is marked by a wharf with 7 feet (2.1 m) of water at its outer end. A plantation settlement is scattered among the trees in the vicinity of the wharf. The landing is occasionally used by sampans, but steamers do not call anywhere in the bay. A 56° true (NE. mag.) course, with the wharf ahead, passes 250 yards southward of the 3-fathom (5.5 m) broken ground previously described; anchor in 6 fathoms (11 m) when 700 yards off the wharf. There is a prominent pump stack about 2½ miles north-northeastward of the wharf.

Kealia Pond lies just northwestward of Kihei and is separated from the bay by a narrow sand strip over which the shore road passes.

Maalaea Village, in the northwesterly part of the bay of the same name, is marked by a few buildings among the algaroba trees along the shore. Small boats with local knowledge anchor in shallow water inside the reef which extends 400 yards offshore. There is no landing, but pulling boats can be hauled out on the gravel beach. The shore of the bay between Maalaea and McGregor Point consists of low rocky bluffs with short stretches of sand beach. About ¾ mile northeastward of Maalaea village and ¼ mile inland is a landing field.

Hele Hill, a prominent cone 214 feet (65 m) high, is situated 1¼ miles north-northeastward of Maalaea village. Several stacks in the Kahului district, on the northern side of the isthmus, may be seen from Maalaea Bay.

McGregor Point, marked by a concrete structure of a former light, is on the westerly side of Maalaea Bay. The coast between McGregor Point and Olowalu is broken by low bluffs rising from the water's edge, behind which the country presents a barren appearance. The mountains are surmounted by sharp jagged peaks and cut up by deep gorges.

Papawai Point, ⅞ mile westward of McGregor Point, is the southernmost point of the western peninsula of Maui, and has deep water close-to.

Olowalu, on Hekili Point, 5 miles west-northwestward of Papawai Point, is marked by a mill with a tall prominent stack. The landing is no longer used, as sugar is transported by rail to Kaanapali for shipment. The old wharf, with only a few feet of water alongside, is situated near the mill, and should be approached at high tide only, as the shallow entrance across the reef is generally affected by surf and swell. About ¼ mile eastward of the landing

foul ground extends offshore for nearly ¼ mile. Vessels can anchor about ⅜ mile off the wharf in 15 fathoms (27.4 m). Cane fields extend 2 miles eastward from Olowalu. The deep gulch of Olowalu Stream appears as a gap in the mountains when abreast Hekili Point, making an excellent night mark.

Launiupoko Point, about 2 miles northwest of Olowalu, is low and rounding. Shoal water extends about ¼ mile offshore from this point northwestward to Lahaina. About ¾ mile inland from the point is an 808-foot (246 m) hill which has a mottled, grayish-brown appearance at the summit. Between Maalaea Bay and Lahaina the highway skirts the shore, and the automobile lights along the road are usually the only lights seen along the coast.

Lahaina Anchorage, 5 miles northwestward of Olowalu, is marked by a flashing red light. It is a good anchorage and is generally calm even though strong trades are blowing elsewhere. It is exposed to kona weather. There is a small wharf with 3 feet (0.9 m) of water alongside. The wharf is covered with a roof. Lahaina village is situated among the trees immediately in from the beach. There are two or three small hotels. Gasoline, water, and some supplies may be obtained in limited amounts. Passengers and freight for Lahaina are now landed at the Mala wharf, 1 mile northward.

Prominent objects.—The most prominent feature in the vicinity of Lahaina is the tall, white, concrete stack of the Pioneer Mill, which is located ⅜ mile north-northeastward of the wharf. Lahaina Light, on a white tower, is situated on the northerly side of the inshore end of the wharf. A short distance southeastward of the landing is a tall white flagpole in front of the courthouse.

Lahaina anchorage buoy is about 700 yards southwestward of the wharf in 9 fathoms (16.5 m). It is equipped with reflectors.

Anchorage.—In approaching Lahaina vessels should keep about 1 mile offshore until the wharf or light bears 56° true (NE. mag.) and then head in on this course until near Lahaina buoy; anchor in 10 to 15 fathoms (18.3 to 27.4 m).

Dangers.—A reef, over which the sea generally breaks, fringes the shore in front of the town and for several miles on each side. There is a boat passage through the reef in line with Lahaina buoy and the end of the wharf.

Breakwater.—There is a small breakwater parallel to the shore on the southeasterly side of the landing. It has been partly washed away by the seas, but still affords some shelter for boats of 2-foot (0.6 m) draft. Larger sampans anchor in back of the reef on the northern side of the wharf.

Currents.—The current off Lahaina sets northward on the ebb and southward on the flood; the northerly current is the stronger and may reach a velocity of 2 knots about one hour before low water. A slight southerly current of short duration may be expected 1 or 2 hours before high water.

Cane fields extend along the coast and for several miles inland on the ridges that lead to high, rugged mountains.

Puunoa Point, 1 mile northwestward of Lahaina Light, is low, covered with trees, and is marked near its outer end by a tall radio mast. A reef, over which the sea generally breaks, extends for ¼ mile off the point. The outer end of the reef is marked by Mala lighted buoy.

Mala, about 1 mile northwest of Lahaina, is the location of a modern concrete wharf, 960 feet (293 m) long. There is a depth of 32 feet (9.8 m) at the end of the wharf. Along the north side, 100 yards from the end, this depth decreases to 21 feet (6.4 m), while on the south side, 80 yards from the end, there is a depth of 25 feet (7.6 m). The wharf has a small warehouse and a derrick on its outer end. Close to the inshore end of the wharf is a silver-colored oil tank, and a warehouse with the name "LAHAINA" in large letters on its roof. A large pineapple cannery is situated near the shore, about 300 yards northeastward of the wharf. A refuse outfall extends a short distance into the water from the cannery, and has the appearance of a small wharf.

Anchorage can be had anywhere in the bay north of the wharf, ⅝ mile offshore, in about 12 fathoms (21.9 m), sandy bottom. Passenger steamers usually anchor off the wharf and send small boats to the landing. Local freighters usually approach from the northward, drop anchor when off the end of the wharf, and maneuver to a port landing at the northeastern side of the wharf. Lines are run to the two mooring buoys off the northeasterly side of the wharf. A confused current makes it difficult to approach or lie at this wharf at times.

Laina Hill, 1¼ miles northeastward of Mala wharf, is a prominent cone 647 feet (197 m) high, the lower slopes of which are covered with cane. A gray-colored rock crusher, 1½ miles north of Mala and close to the shore, can be seen from the westward and southward only. The coast between Mala and Kekaa Point consists of a low sandy beach with a fringe of coconut and algaroba trees, back of which the cane fields extend inland for about 2 miles. **Hanakaoo Point**, 2 miles north of Mala, is rounding and not conspicuous from offshore. The 10-fathom (18.3 m) curve is about 500 yards off this point, and the bottom slopes gradually to the sandy beach.

Kekaa Point is the westernmost point of Maui and is a dark, rocky promontory 85 feet (25.9 m) high; from a distance it appears detached. There are no dangers off the point.

Kaanapali Landing, on the northerly side of Kekaa Point, is the shipping point for all the sugar produced along this coast. Large ocean steamers approach from the southwest and moor to buoys about 300 yards off Kekaa Point, in 15 fathoms (27.4 m). Sugar is loaded from numerous lighters. Launches of 4- or 5-foot (1.2 or 1.5 m) draft can go alongside the landing during normal weather. There is a pump house, with a short steel stack, on the landing. A large warehouse and a black tank are situated near the turn of the beach, a short distance eastward of the landing. A pilot is available.

Anchorage can be found in 10 to 20 fathoms (18.3 to 37 m) about ¼ mile northwestward of the landing.

There is frequently a strong northerly current at Kekaa Point; the southerly current is not so strong and is usually of shorter duration. The direction of the current may easily be noted from offshore by observing the heading of the lighters moored to the numerous buoys extending northward from the landing.

The tall light-colored stack of the pump station at **Honokowai**, 1¼ miles northward of Kekaa Point, is the most prominent landmark of the vicinity. The coast from Kekaa Point to **Lipoa Point**

consists of a series of low bluffs and stretches of sand beaches, along which may be seen clumps of algaroba trees. The country slopes gently, is more or less cut up by shallow gulches, and is covered with cane which extends well up the mountain slopes.

Napili Bay, 4½ miles northward of Kekaa Point, is a small bight between two coral reefs, where an anchorage can be found about ½ mile offshore in 5 fathoms (9.1 m). It is seldom used. Small boats can land here in trade-wind weather. Breakers extend ¼ mile offshore for a distance of 1½ miles southward of the bay.

Hawea Point, 5 miles northward of Kekaa Point, is marked by Hawea Point Light.

Honolua Bay, about 1 mile northward of Napili Bay, is the open bight lying between Hawea Point and Lipoa Point. A fair anchorage can be found for small vessels southward of Lipoa Point. Small boats can land in the cove in the northeastern end of the bay.

In the vicinity of Lipoa Point the bluffs along the northern shore of Maui become higher and more precipitous, and are more cut up by bights and headlands. The country is more rolling and cut by deeper gulches. The mountains are steeper and greener and near their tops are wooded in places. Patches of black rocks that show above water are found close inshore off several of the points in the vicinity. Vessels should give this coast a berth of at least ¾ mile.

Kanounou Point, about 2 miles east-northeastward of Lipoa Point, has several bare black rocks a short distance offshore.

Nakalele Point, about 3 miles east-northeastward of Lipoa Point, is marked by Nakalele Point Light. There are several bare black rocks off the point, close to the shore.

Honokohau, on the west side of Kanounou Point, consists of a few houses in the mouth of the gulch of the same name. It is the northern terminus of the road which skirts the western shore of Maui. There is but little protection here.

Kahakuloa Head, 3 miles east-southeastward of Nakalele Point Light, is marked by **Puu Koae** (Sugarloaf), a dark, bare, conical mound 634 feet (193 m) high; the seaward end of one of the numerous ridges that ends abruptly at the sea. Close to Puu Koae and just eastward, on the end of the same ridge, is a low and more rounded dome. There is deep water close to the Head. **Kahakuloa** is a small village in the bight just west of Kahakuloa Head. A rock awash lies ⅜ mile off the head of the cove between Puu Koae and Mokeehia.

Mokeehia Island, 1½ miles southeastward of Puu Koae, is a large, bare rock 170 feet (52 m) high, on the outer end of **Hakuhee Point.** From a distance it looks like an island, and caverns can be seen in the face of the cliffs on both sides of the rock. **Olai Hill,** ¾ mile inland from Mokeehia, is 1,002 feet (305 m) high, and marks the northern end of the road from Wailuku. Pineapple fields may be seen in this vicinity.

Hulu Islets, 2 miles southward of Mokeehia, are several rocks close to the shore, the highest of which is 95 feet (29 m).

About 3½ miles southeastward of Mokeehia Island is a reef that extends about ¾ mile offshore. Waihee Reef lighted buoy is 1 mile southeastward of the reef and 1 mile offshore. The buoy is moored in a depth of 16 fathoms (29.3 m), and is about 100 yards west of the entrance range to Kahului Harbor, 1¾ miles southward. Waihee plantation settlement is a short distance inland and westward of the reef, in the midst of cane fields.

Waihee Valley, 2½ miles southeastward of Mokeehia Rock, is deep and has precipitous sides. It is covered with verdure and is quite prominent.

Iao Valley is deep, with steep sides, and is also covered with verdure and some of the finest scenery in the islands is to be found here. The town of **Wailuku** lies in the mouth of the valley. Wailuku is connected with Kahului by railroad.

KAHULUI HARBOR (CHART 4105)

is 6¼ miles southeastward of Mokeehia Island and is the most important harbor in the island, as well as the only one with protection from all weather. The harbor is formed by two breakwaters extending out over shoals; one northeasterly from the west side, and the other northwesterly from the northeast side of the bay. The entrance between the breakwaters is 240 yards wide. The harbor is about ⅝ mile in diameter; the shallow southwestern half is marked by two lighted buoys (flashing green). The controlling depth of the harbor is 31 feet (9.4 m), and the general depths are 33 feet (10.1 m). The shores of the bay are low and sandy. The outer end of the east breakwater is marked by a flashing white light, with a red sector covering the shoals to the northeastward. The outer end of the west breakwater is marked by a flashing red light.

Range.—A lighted range (both lights fixed red) leads to the entrance on course 177° true (S. by E. ¼ E. mag.). The range structures are painted white and are easily seen. Waihee Reef lighted buoy is 1¾ miles northward of the breakwaters and about 100 yards west of the line of the entrance range.

Wharves.—There are two modern wharves, owned by the Territory on the eastern side of the harbor. They both have large warehouses, extensive cargo-handling equipment, and rail connection. Pier No. 1, at the inshore end of the east breakwater, has a length of about 1,000 feet (305 m), a depth of 31 to 33 feet (9.4 to 10.1 m) alongside, and is used by large ocean steamers. Pier No. 2, parallel to and 270 yards southwest of No. 1, is about 850 feet (259 m) long, has a depth of 29 to 33 feet (8.8 to 10.1 m) along its northeast side, and shallow water along its southwest side. Interisland steamers dock at this pier.

Prominent features.—The most prominent landmark is the 140-foot (43 m) aluminum-colored water tank of the pineapple cannery, located just west of the rear entrance range. The large gray building known as the Rock Crusher, situated 400 yards northwestward of the inshore end of the west breakwater, is prominent. About 1 mile southeastward of the harbor is the 180-foot (55 m) concrete stack of the power station. The Wailuku mill stack is situated about 1¼ miles west of the harbor. Puunene mill twin stacks, 1¾ miles southeastward of the harbor, are black and fairly prominent. The town of **Kahului,** situated on the southeasterly shore of the bay, does not show up well because of the trees.

Pilotage is not compulsory, but vessels without a coasting license are required to pay half fee when a pilot is not taken. (See appendix.)

Towboats.—There is a small towboat in the harbor.

Communication.—There is frequent communication with the other islands by steamer and by air. There is a good telephone and radiotelephone service.

Harbor master.—The harbor master, who is also the pilot, designates the moorings and anchorages for the various vessels. Large vessels do not ordinarily anchor within the breakwaters because of the restricted swinging room.

Dangers.—A shoal extends for a distance of 650 yards off the western shore of the harbor, and as there is frequently a strong easterly wind, vessels are cautioned against being set to westward.

Supplies.—Provisions, fresh water, and some ship chandlers' stores, as well as fuel oil and gasoline, can be obtained at Kahului. There are good hotels and stores at Wailuku, 2 miles westward.

Repairs.—There is a small marine railway, located just eastward of Pier No. 2, where boats of 6-foot (1.8 m) draft can be hauled out. There are no dry docks. There are machine shops where minor repairs can be made.

Winds.—The prevailing winds are the northeast trades, and they frequently blow with great force across the isthmus.

Reef.—A reef about ¾ mile wide begins at the easterly entrance to Kahului Harbor and fringes the coast in an east-northeasterly direction until almost up to Pauwela Point, which is marked by a light. It is marked at its widest point by Spartan Reef can buoy (black, No. 1), which lies about 3¼ miles northeastward of the breakwater at Kahului and 1¼ miles from shore. The coast between Kahului Harbor and Pauwela Point Light is low, and the country back of it is covered with sugarcane.

Kanaha Pond, situated ½ mile east of Kahului, is a shallow lake about ½ mile long. It is connected with the sea at its northwesterly side by a short drainage canal.

Spreckelsville, 3 miles east of Kahului and just inland from Papaula Point, is a plantation settlement which is not conspicuous from offshore.

Paia, 5 miles east of Kahului, is a plantation settlement marked by several black stacks and mill buildings; one stack is low down and near the shore, while two or three others are a short distance inland on higher ground. There is an opening in the reef off Paia that is sometimes used by launches to enter an anchorage behind the reef. Local knowledge is necessary. The lights of the settlement are numerous and are conspicuous at night.

Maliko Cove, about 2½ miles northeast of Paia, is a narrow opening with steep rocky sides. It is a good anchorage for small boats and launches when the trade winds are blowing, as the rocks off the east side of the entrance extend about halfway across the mouth, forming a natural breakwater. Anchor in about 4 fathoms (7.3 m), rocky bottom.

Pauwela Point, 9 miles northeastward of Kahului, is marked by a group flashing white light, and the lightkeeper's dwelling. **Pauwela Village** is 1 mile inland from the point, and is marked by the buildings and three black stacks of a pineapple cannery.

The villages of **Haiku** and **Hamakuapoko** are situated between Paia and Pauwela, and 1¼ miles inland. Several hills, with heavily wooded tops, are situated within a 2-mile radius of Pauwela.

From Pauwela Point to Nahiku, a distance of about 15 miles, the bluffs become higher, in many places reaching heights of between 300 and 400 feet (91 and 122 m). Eastward of Nahiku the bluffs become gradually lower, and when Kauiki Head is reached they are low. Sugarcane ceases to be a characteristic feature of the coast after passing Pauwela Point until within about 5 miles of Kauiki Head. The country is green, and the higher slopes are heavily wooded. It is cut up by numerous gulches, and on account of the heavy rains, numerous waterfalls empty into the sea. Pineapples are grown along the slopes for a distance of 10 miles southeastward from Pauwela Point. The Kahului-Hana highway may be seen along this coast, in some places along the shore, while in other places it is high up the slopes and 1 or 2 miles inland. Between Pauwela Point and Kauiki Head there are a number of rocks close inshore, but by keeping 1 mile offshore all dangers will be avoided.

Uaoa Bay, 3 miles east of Pauwela Point and just east of Opana Point, indents the coast about 3/8 mile. It is a fair anchorage for vessels during southerly winds. Anchor 1/4 mile offshore in 12 to 16 fathoms (21.9 to 29.3 m), sandy bottom. A large detached rock off **Opana Point** marks the western side of the bay.

Pilale Cove, 1 mile east of Uaoa Bay, is a small bay at the mouth of a steep valley. It is a very good anchorage for small boats and launches when the trade winds are blowing. Anchor in 4 or 5 fathoms (7.3 or 9.1 m) a short distance off the beach.

Honopou Cove, 1 mile east of Pilale Cove, is an abandoned landing place. A sunken rock off the entrance usually breaks with only a slight sea running. When a heavy swell comes in from the north, the breakers on the rock continue on into the cove, increasing in size and force.

Waipio Bay, 6 miles eastward of Pauwela Point, lies between Honokala and Huelo Points. It is open to the northeast. **Huelo Village,** along the highway 1/2 mile inland from the bay, is marked by a conspicuous, green schoolhouse with red roof, and two churches about 1 mile apart.

Hoalua Cove, 2 miles southeast of Honopou Cove, can sometimes be used as an anchorage for small boats and as a landing place when the trade winds are blowing.

Oopuola Cove, 1 1/2 miles southeast of Hoalua Cove, is narrow and has steep sides. Landings can be made here at times, or an anchorage found for small boats in from 3 to 6 fathoms (5.5 to 11 m) near the center of the cove. **Kukai Hill,** 574 feet (175 m) high, is 1/2 mile westward of Oopuola Cove.

Keopuka Rock, 1 1/2 miles southeast of Oopuola Cove, lies close to the shore and is 141 feet (43 m) high. Southwest of the rock is a small cove that furnishes a fair anchorage for launches in trade wind weather. Anchor in from 3 to 5 fathoms (5.5 to 9.1 m) near the head of the cove.

Honomanu Bay, 1 mile southeast of Keopuka Rock, is a good landing place and a fair anchorage for small boats when the trade winds are blowing, although the swell is felt in the bay. Anchor in 2 or 3 fathoms (3.7 or 5.5 m) about 200 yards from the black shingle beach at the head of the bay. There is shoal water on the east side. There are two or three small houses near the shore at the head of

the bay. The bay is at the mouth of the valley of the same name. **Okohola Hill,** 844 feet (257 m) high, is ½ mile west of the bay.

Keanae Point, 1¾ miles southeast of Keopuka Rock, is low and juts out ¼ mile from the bluff line. There are clusters of trees, and a yellowish church with a steeple on the point. One lone coconut tree, well out on the point, is conspicuous from a short distance offshore. On the 100-foot (30 m) bluff on the southwest side of the point are several small red-roofed dwellings and a large red-roofed warehouse which show up well from offshore. There is an old landing, with a derrick on it, near the foot of the bluffs on the northwest side of the point. The landing is no longer used. A black rock, about 15 feet (4.6 m) high, lies nearly ⅛ mile offshore and westward of the landing. Small vessels can anchor in 8 fathoms (14.6 m) immediately westward of the point. This anchorage should not be attempted without local knowledge.

Keanae Valley, just eastward of Keanae Point, is the largest and most prominent valley on this part of the island. It leads inland 7 miles to **Koolau Gap,** the large opening in the northern rim of Haleakala Crater. Three high rocks close inshore form the most prominent landmark in this vicinity.

Pauwalu Point lies 1 mile east of Keanae. **Mokumana Rock** lies just off the point. It appears almost as a continuation of the point, with an opening 30 yards wide separating the two. A green schoolhouse with a red roof may be seen inland from the point.

Waiokilo Anchorage is in 9 fathoms (16.5 m), sandy bottom, about midway between Pauwalu Point and the bight at Wailua; about ¼ mile northward of Aluea Rock and 400 yards offshore. It is entirely exposed to the trade winds, but is a fair anchorage in southwesterly weather.

Aluea Rock lies about ¼ mile offshore and ⅞ mile southeastward of Pauwalu Point It is only a few feet high and the sea breaks over it continuously. Sunken rocks extend about 300 yards farther offshore from Aluea Rock.

Wailua consists of a few houses along the shore of the small bight immediately southward of Aluea Rock. The east point of the bight is a high wooded bluff, while the west side is low and grass-covered. Taro is raised in the flat in back of the trees along the shore of the bight. The Hana road leaves the shore about ½ mile west of here, and may be seen from seaward as it winds its way southward, high up on the ridges.

Nahiku Anchorage, 2½ miles southeastward of Pauwalu Point, is in the open bight off Nahiku, in 7 fathoms (12.8 m), close inshore. Strangers should not attempt this anchorage, as there are two sunken rocks near shore. There is a small settlement southeastward of the anchorage. **Kuhiwa Gulch** may be seen 3 miles inland (south by westward) of Nahiku.

Opikoula Point, at the easterly side of Nahiku anchorage, is a low rocky bluff. The coast from here to Pukaulua Point, a distance of 5 miles, consists of low rocky bluffs, with no easily recognized landmarks.

Pukaulua Point, 2½ miles northwestward of Kauiki Head, forms the northern side of a small bight which is open to the eastward. The point is low and covered with uncultivated vegetation.

Kaeleku, about 1 mile inland from Pukaulua Point, is a plantation settlement with a large number of evenly spaced laborers' cottages. Eastward of the cottages is a conspicuous red church with steeple.

Alalakeiki Channel, between Maui and Kahoolawe, is about 6 miles wide and clear of dangers, with the exception of Molokini, which is marked by a light. The trade winds draw through the channel, hauling around the north end of Kahoolawe. The trades blow with much force at the easterly entrance to the channel, but in the vicinity of Molokini it is generally calm. The currents are variable.

Auau Channel lies between Maui and Lanai and is about 8 miles wide. With the exception of a reef about 3 miles long, which extends not more than ⅓ mile offshore northward of Wahapuu Point, Lanai, the channel is free from obstructions. During trade winds it is often calm in the channel. In the middle of Auau Channel the current sets northerly, but in the vicinity of Lahaina it flows north on the ebb and south on the flood.

Pailolo Channel, between Maui and Molokai, is about 7½ miles wide and is clear of obstructions with the exception of Mokuhooniki and Kanaha Rock, near the easterly end of Molokai, and a reef about ¾ mile wide which fringes the shore of Molokai. Kamalo Point Reef lighted buoy marks the edge of the reef off the southeasterly point of Molokai.

KAHOOLAWE (CHART 4130)

with an area of 69 square miles, is eighth in size of the islands, and lies 6 miles southwestward of the southwesterly end of Maui. It is about 10 miles long and 6 miles wide, and from a distance has an even, unbroken appearance. The high cliffs on the eastern and southern sides are almost black, while the soil of the mountain tops and the gentle slopes of the northern and western sides are reddish in color. There is scarcely any rainfall, and the huge clouds of red dust which trail to leeward during strong winds can be seen for many miles. There are no permanent inhabitants, although cattlemen and fishermen camp on the island at times. The island supports a few cattle and sheep, but there is no cultivation. **Mount Moaula**, a brown dome 1,429 feet (436 m) high, near the easterly end of the island, is the most prominent landmark.

From **Cape Kuikui**, the most northerly point of the island, to Kanapou Bay the coast is rocky and the bluffs gradually increase to cliffs several hundred feet high at the bay.

Kanapou Bay, 2 miles wide between Ule Point and Halona Point, offers protection in kona weather, and an anchorage can be had (except for large vessels) in **Beck Cove** in the southwest side of the bay. Enter on a southwesterly course, heading for the center of the cove, and anchor in from 15 to 20 fathoms (27 to 37 m) off the mouth of the cove and midway between the sides. The bottom shoals rapidly from 12 to 3 fathoms (21.9 to 5.5 m), about ¼ mile from the sand beach at the head of the cove. The wind draws down the canyon at the head of the cove with considerable force during westerly winds.

From **Kaka Point,** the southeastern point of the island, to within a mile of Smuggler Cove on the southwest side, the coast consists of sheer cliffs which reach a maximum height of 800 feet (244 m) at Kamohio Bay. There are no off-lying dangers. **Kamohio Bay** and **Waikahalulu Bay,** 3 and 6 miles west of Kaka Point, each indent the coast about 5/8 mile; they cannot be recommended as anchorages on account of the deep water close to the shores. They are subject to strong gusts which sweep down over the high cliffs when the trades are blowing. Kamohio Bay is marked on its westerly side by **Puukoae Island,** a black mass of rock 378 feet (115 m) high about 100 yards offshore. Kahoolawe Southwest Point Light marks the westerly side of Waikahalulu Bay. The prevailing current is westerly along the south coast of Kahoolawe.

Smuggler Cove, 1 mile southwestward of Kealaikahiki Point, the westernmost point of the island, is the best anchorage except during westerly or southerly weather. Anchor in 10 to 12 fathoms (18.3 to 21.9 m) 1/2 mile off the sand beach. The best landing for boats is on the sand beach close to the conspicuous black rock at the head of the cove. There is a stream here (which is usually dry) and a clump of algaroba trees. The shore is low, with alternate stretches of sand and rocks. The prevailing current at the anchorage is northwesterly. **Kuia Shoal,** with a least depth of 1 fathom (1.8 m), extends 1 mile westward from Kealaikahiki Point, and vessels should give the point a berth of at least 1 1/2 miles in rounding. The country slopes up evenly and gradually from Kealaikahiki Point to the eastward.

The northwest coast is generally rocky, with a line of low bluffs from which the country slopes gently up to the reddish hills in the center of the island. There are scarcely any distinguishing marks, and no off-lying dangers. **Kuheia Bay,** 2 miles southwestward of Cape Kuikui, is a very small bight where boats can land at times. There are two or three buildings, one of which has a galvanized iron roof which shows up well when the sun is right.

Kealaikahiki (the way to Tahiti) **Channel** lies between Kahoolawe and Lanai and is about 15 miles wide. It is free from obstructions. Sailing vessels should avoid this channel during trade winds, as long periods of calms sometimes occur southward and westward of Kahoolawe and Lanai.

LANAI (CHARTS 4130, 4116)

the sixth in size of the islands, lies about 8 miles westward of west Maui and the same distance southward of the easterly end of Molokai. It is about 15 miles long in a northwesterly direction and about 10 miles wide near its southeasterly end, gradually narrowing toward its northwesterly end. The highest point is **Mount Lanaihale,** 3,370 feet (1,027 m) high, located 3 1/2 miles inland from the southeastern side of the island. The slopes on the easterly side of the mountain are steep and cut up by gulches, while those on the westerly side are more gradual, terminating in a rolling plain between the 1,000- and 2,000-foot (305 and 610 m) levels. There is but little rainfall, and, in general, the island presents a barren appearance. The central portion of the island is covered with extensive pineapple fields which, being on a high plain, are not easily seen from the sea. The

census of 1930 gave Lanai a population of 2,356 inhabitants. Pineapple cultivation is the principal occupation, although some livestock is raised. **Lanai City**, built in the center of the island by the pineapple company, is the only large village.

From **Kikoa Point** (also known as Wahapuu Point), the easternmost point of Lanai, to Kamaike Point, about 3½ miles southwestward, the coast is low, sandy, and brush-covered. A coral reef fringes the shore from 100 to 200 yards off the beach. At Kamaiki Point low bluffs appear, gradually increasing in height until close to Manele Bay, where they reach a maximum of about 400 feet (122 m).

Manele Bay, on the south side of the island, is about ¼ mile wide and indents the coast about ¼ mile. The shores are rocky except for the sand beach at the head of the bay. The bay is ½ mile northeastward of Puupehe Rock. There is an old cattle chute on the west side of the bay, and a boat landing at the westerly side of the sand beach, where small boats can land in most any weather. A detached low rock, over which the sea usually breaks, lies about 300 yards off the easterly entrance point. Small local steamers occasionally anchor in 14 fathoms (25.6 m) about 350 yards southwestward of this rock. There are no houses in the vicinity of Manele Bay.

Under certain conditions when the trade winds are blowing, squalls will alternate from the head of the bay and from the northeast. This causes an anchored vessel to swing considerably, and it usually will be found advantageous to shift anchorage to the bay west of Puupehe Rock, where the squalls will not be so pronounced.

Puupehe Rock is 110 feet (34 m) high, brown colored on its steep sides, and has a flat, grass-covered top. It is the most prominent landmark along this section of the coast. Rocks over which the sea usually breaks, extend for 300 yards eastward and southward from Puupehe Rock, which is separated from the shore by a short, low sand spit. The bay just to the west of Puupehe Rock has a sandy beach at its head. Anchorage may be found about 400 yards from the head of the bay in 8 fathoms (14.6 m), sandy bottom.

From Manele Bay to Cape Kaea, the southwesterly point of the island, the coast consists of low bluffs, behind which the land rises in steep slopes to the table-land above. There is a high, detached, grass-covered rock close to the shore 1¾ miles west of Puupehe Rock. There are many small rocks close to the shore; one, awash at times, 400 yards offshore and about 2 miles east of Cape Kaea. No houses or other buildings can be seen along this coast.

Cape Kaea (Palaoa Point), is a rocky, double point with a small bight between. Small boats can usually make a landing on the rocky shore of the bight during trade winds. A small, black rock about 5 feet (1.5 m) high is situated about 200 yards off the northerly side of the point. Another rock, about the same distance offshore but ¼ mile northward, is 28 feet (8.5 m) high.

From Cape Kaea the coast has a north-northwesterly trend, and between the cape and Kaumalapau Harbor, it consists of sheer bluffs (**Pali Kaholo**) over 1,000 feet (305 m) high in places. The bluffs are marked by two landsides—one, very large and conspicuous, is 1½ miles northward of Cape Kaea; the other is not so large and is 2½ miles northward of the cape.

Kaumalapau Harbor (chart 4122), 3½ miles northward of Cape Kaea, is a small bight at the mouth of the most prominent gulch in the vicinity. It is the best harbor on the island in all but westerly weather. There is a short breakwater and sea wall on the northerly side, back of which is a substantial wharf with 28 feet (8.5 m) of water alongside. The bight has been dredged so that towboats can place large pineapple barges at the wharf for loading. There is not room for large vessels within the breakwater, and local steamers anchor off the harbor; pulling boats are used to land passengers and freight.

Kaumalapau Light marks the south entrance point of the harbor. A flashing red light on the outer end of the breakwater marks the northern side of the entrance. A reef, projecting out 100 yards from the eastern shore of the harbor, is marked by a red nun buoy. Another red nun buoy marks the edge of deep water on the northern side of the south entrance point. There are three mooring buoys, one near the center of the bight and two off the eastern end of the wharf. Shoal water extends 150 yards northwestward from the breakwater. A good road leads eastward, on a steep grade, to Lanai City, 5 miles inland. A group of silver-colored oil tanks, 100 yards in from the wharf and on high ground, is a good offshore mark. There are a few houses among clumps of trees on the bluff above the harbor. There is radiotelephone communication with Honolulu.

An indifferent anchorage can be had in about 22 fathoms (40 m), sand and coral bottom, with the breakwater light bearing 64° true (NE. ¾ E. mag.) and 300 yards distant.

Between Kaumalapau and Kaena Point the coast is a series of bluffs, in some places precipitous and 300 to 400 feet (91 to 122 m) high. The shore is rocky, with a few short stretches of sand. In general the bottom is fairly steep-to, although small steamers can find anchorages with sufficient swinging room in some places. At times when the trades are blowing, the wind sweeps down the gulches in heavy gusts which are felt for a mile or more offshore. There are no houses or trees of any size along this coast and it presents a barren appearance.

Five Needles are about 2¼ miles northward of Kaumalapau and about the middle of the westerly side of the island. They are a group of detached pinnacle rocks, the outermost being about 300 yards offshore and 32 feet (9.8 m) high; the inner pinnacle is 110 feet (34 m) high. They are of the same material as the higher cliffs of the shore and are therefore not easily recognized from offshore.

Keanapapa Point, 7½ miles northwestward of Kaumalapau, is the westernmost point of Lanai. It is low and rocky and is marked by a small knoll 150 yards in from the shore. A small detached rock 8 feet (2.4 m) high and 150 yards offshore lies 1⅞ miles southeastward of Keanapapa Point. The cliffs, which are 200 feet (61 m) high in the vicinity of this rock, gradually diminish in height until they are only 20 or 30 feet (6.1 or 9.1 m) high about ½ mile southward of Keannapapa Point.

Kaena Point, 1 mile north of Keanapapa Point, is low and rocky and hard to distinguish from the other points in the vicinity. The low, rounding, unlighted northwest coast of Lanai is not easily seen at

night and vessels should give it a berth of at least 1 mile, although ½ mile will clear all dangers. There are many small, rocky points and short, sandy indentations in this vicinity; boats can land in the lee of the points at times.

About 1¼ miles eastward of Kaena Point is the west end of a long, sandy beach. There is no reef at this particular place, and in favorable weather boats can land on the sand close to the low, rocky bluffs extending westward. Eastward of this landing place a coral reef fringes the sandy shore along the northern and eastern sides of the island, extending ¼ mile offshore in places. Back of the low section of the beach there is generally a narrow, low strip of land which rises gently to the table-land. The vegetation consists of low brush, cactus, and a few small trees. There is no cultivation, nor are there any villages.

Pohakuloa Point, 4 miles eastward of Kaena Point, is the most northerly point of the island. It is low and so rounding that it does not appear as a point. On the eastern side of this point, at a place called **Awalua,** is an opening in the reef about 150 yards wide which permits a landing for small boats. The opening is marked by an old windmill among trees near the shore. The windmill, as well as the opening in the reef, is difficult to make out from a distance. About ½ mile westward of the point and on the reef, 400 yards offshore, are the engines and boilers of an old wreck, which have the appearance of two or three small, regular-shaped rocks.

Lanai north beacon, on the shore 5 miles east of Pohakuloa Point, is an unlighted, white skeleton tower 40 feet (12.2 m) high. Directly offshore and ¾ mile northward of the beacon is Kalohi Channel Reef lighted buoy, moored in 15 fathoms (27.4 m). About ⅞ mile westward of the beacon and 300 yards offshore is a conspicuous part of an old wreck. A windmill and tank are situated a short distance in from the shore about 1 mile southeastward of the beacon. **Maunalei Gulch** is inland from the windmill and tank; it is forked and so cannot be confused with the deep **Hauola Gulch,** 2½ miles southeastward.

There are no roads or villages of any size on the north or the east coasts of Lanai, and lights are seldom seen on the shores.

Kehamoku, about 6 miles southeastward of Lanai north beacon, consists of a few houses and a church, none of which are very prominent from offshore. There is an opening in the reef, and small boats of less than 4-foot (1.2 m) draft can find anchorage behind the reef south of the entrance.

Halepalaoa, 1½ miles southeast of Kehamoku, is a small settlement situated at an opening in the coral reef. There is a small wharf, in a poor state of repair, with about 3 feet (0.9 m) of water at its outer end. Vessels should give the northeast coast of Lanai a berth of at least ¾ mile.

Kalohi Channel lies between Lanai and Molokai and is about 8 miles wide. With the exception of a reef about ¾ mile wide, which fringes the shore of Molokai, and the reef about ¼ mile wide along the Lanai coast, the channel is free from dangers. The prevailing current in the middle of Kalohi Channel is easterly, although it is westerly for a short period at the time of the lower high waters.

Counter currents may be expected close to the Molokai side of the channel. The south side of the channel is marked by Kalohi Channel Reef lighted buoy, while the north side is marked by Kamalo Point Reef lighted buoy. The easterly trade winds draw through the channel with an increased force.

MOLOKAI (CHARTS 4116, 4130)

the fifth in size of the islands, lies 7½ miles northwestward of Maui and 8 miles northward of Lanai. It is more or less rectangular in shape and is about 34 miles long in a westerly direction and about 7 miles wide. The easterly end is mountainous, its summit being **Kamakou Peak,** 4,970 feet (1,515 m) high. On the northerly side the mountain slopes are very steep, in many places being almost perpendicular, and there are numerous deep gorges with precipitous sides. On the southerly side the slopes are gradual, cut up with gorges, and terminate in a narrow strip of rolling land near the coast. On the westerly side the land slopes gently, is cut up by gulches, and here and there an extinct crater can be seen. About 10 miles from the westerly end of the island the plain is only a few hundred feet high and is marked here and there by prominent blowholes. The entire westerly end of the island is a bare table-land cut up by small gulches and rising gradually to Mauna Loa, 1,400 feet (427 m) high. From seaward this part of the island presents a smooth and rolling appearance.

Population.—By the census of 1930 Molokai had 5,032 inhabitants.

Winds.—The trade winds divide at Cape Halawa, part following the north shore and another part following the south shore. During a heavy easterly sea it is apt to be quite choppy off this point and vessels should give it a berth of about 1½ miles in rounding. On account of the topography of the island, the trade wind is frequently a little south of east along the south coast of Molokai. This wind is usually light in the early morning but blows with considerable strength during the middle of the day. During strong trades, dust clouds appear over the western end of the island.

Rainfall.—There is a very heavy rainfall on the northeast side. The south and west sides receive very little rainfall.

Communication with Honolulu can be had by steamer and by airplane. A highway skirts the southern shore, and there are other roads in the central and western parts of the island. There is a telephone service on the island, and radiotelephone communication can be had with the other islands.

There are no dry docks or repair facilities. Some stores can be had in limited amounts.

Currents.—The current sets westward along the northerly shore. The prevailing current in the middle of Kalohi Channel (between Molokai and Lanai) is easterly, although it is westerly for a short period at the time of the lower high waters. Along the western half of the south coast of Molokai, a westerly current may be expected. The prevailing current past Laau Point is northerly, and vessels are cautioned against a set onto the point.

COAST OF MOLOKAI

From Cape Halawa, the eastern point of the island, to Kamalo, a distance of about 12 miles, the coast has a general southwesterly trend; thence to Laau Point, a distance of about 25 miles, it has a westerly trend. A reef about 1 mile wide fringes almost the entire coast, its widest point being in the bight about 13 miles eastward of Laau Point. During the day the limits of the reef can generally be told by the breakers, but at night vessels are cautioned to give this coast a good berth. Much land is being reclaimed by the Territorial commission which is establishing native Hawaiians on homesteads in the central part of the island.

Cape Halawa, the eastern point of Molokai, is a brown cliff about 300 feet (91 m) high. Breakers extend about 300 yards off the point and a rock which bares at times is 250 yards offshore. **Lanikaula Hill,** 1 mile west of the cape, is 794 feet (242 m) high. In general, the coast between Cape Halawa and Kaunakakai Harbor is low, but rises, first gently then rapidly, to high, rugged mountains which are much cut up by gulches.

Mokuhooniki is a small, yellow, bare, rocky islet with perpendicular sides 198 feet (60 m) high; it lies about 1 mile offshore and 1½ miles southward of Cape Halawa. **Kanaha Rock,** 95 feet (29 m) high, lies about 50 yards southwestward of Mokuhooniki. There are about 15 fathoms (27.4 m) of water in the passage halfway between the rocks and Molokai.

Honouliwai, 3½ miles southwestward of Cape Halawa, is a small indention in the coast which offers small boats a little protection from the trades, but should only be attemped with local knowledge. About ⅜ mile northeastward of Honouliwai is a small bight (called Honoulimaloo). A yellow church with spire is situated close to the shore and ¼ mile southwestward of Honouliwai. The coral reef begins to trend farther offshore from Honouliwai southwestward.

Waialua, about 4½ miles southwestward of Cape Halawa, consists of a few houses at the mouth of a gulch. It is marked by a red church close to the shore.

Pauwalu Harbor, 5 miles southwestward of Cape Halawa, is a double opening in the reef. The western opening is about 200 yards wide and is usually marked by breakers on either side. Within the entrance there is a small pocket with about 2 fathoms (3.7 m) of water, where a few local sampans find good shelter. Here the reef extends ⅜ mile offshore, and the 10-fathom (18.3 m) curve ¾ mile offshore. A large flat house and a tank near the beach are partly hidden by trees.

About ⅝ mile southwestward of Pauwalu is another opening in the reef, near a place called Kainalu. A red-roofed church is situated close to the shore ⅜ mile westward of this opening.

Pukoo Harbor (chart 4121), 7½ miles southwestward of Cape Halawa, is a pocket in the reef some 500 yards long, narrower at the entrance than inside. An 18-foot (5.5 m) channel about 50 yards wide extends across the entrance bar. Twelve feet (3.7 m) can be carried over the bar for a clear width of 150 yards. A few piling (the remains of an old wharf) extend seaward for 300 yards from the shore. The harbor is smooth during the trades, although the wind sweeps across it with full force. During kona storms breakers

extend across the bar. This anchorage is suitable for small craft only. A small freighter calls occasionally for cattle.

The village of **Pukoo** consists of a few houses on the lowland near the beach in front of a steep-sided gorge which extends well back into the mountains. There are many old fish ponds in this vicinity and along the coast for 10 miles westward. The reef at Pukoo extends 5/8 mile offshore. One mile westward of Pukoo is the village of **Kaluaaha,** where a church steeple may be seen above the trees.

Kalaeloa Harbor, 3 miles west of Pukoo Harbor, is the largest and best protected harbor along this coast, but its use is limited by a 7-foot (2.1 m) bar across the entrance. It is unmarked and consists of an opening in the reef.

Kamalo Harbor (chart 4121), 5 miles west-southwestward from Pukoo Harbor, is a pocket in the reef opening southward. It is about 150 yards wide and extends 1/2 mile inside the reef. The entrance depth is limited by a bar with a general depth of 14 feet (4.3 m), though it is possible to carry 19 feet (5.8 m) into the harbor by passing midway between the two entrance buoys. Kamalo Point Reef lighted buoy lies 350 yards southward from the entrance bar. Spar buoys mark the entrance and the line of the reef inside the harbor. The turning point near the head of the harbor is marked by a day beacon. The coral reefs, marking the limits of deep water within the harbor, are easily seen by day. A wharf, with 19 feet (5.8 m) at its outer face, makes out from the shore. There is a small shed on the outer end of the wharf. Pineapple barges load at the wharf, and a small local freighter calls weekly. This harbor is the only one along the south coast of Molokai that is considered safe during a kona storm. The swell is not felt within the harbor. The reef along the coast in the vicinity of Kamalo extends 3/4 mile offshore.

Papai Hill, 2 miles northwestward of Kamalo wharf, is 830 feet (253 m) high and is 5/8 mile inland. It is bare of trees and has a slightly lighter color than the mountain slopes in the background. **Kamalo Gulch** is deep and lies 1 mile east of Papai Hill. **Kawela Gulch,** 2 1/2 miles west of the hill, extends well inland from the small village of the same name.

From Kamalo, the most southerly point of Molokai, the coast has a west-northwesterly trend, and the reef extends 5/8 mile offshore until near Kaunakakai, where it is 3/4 mile offshore.

Kaunakakai Harbor (chart 4121), 9 miles westward of Kamalo Harbor, is a pocket, 600 yards long and 200 yards wide, in the reef and open southward. It is an anchorage for small craft only, on account of the limited swinging room. Kaunakakai lighted buoy is moored in 13 fathoms (23.8 m) at the east side of the entrance to the harbor. Buoys mark the limits of the reef inside the harbor. There is a lighted range; the front is flashing white, and the rear is occulting white. The range structures are painted white and are easily seen by day. A rock and gravel mole extends 3/8 mile from the shore, in a southwesterly direction, to the concrete wharf which has 12 feet (3.7 m) of water along its outer, westerly face. There is a greater depth a few yards off the wharf, and small steamers drawing as much as 14 feet (4.3 m) can go alongside, although there

is limited maneuvering room. The local steamer calls here biweekly, and large pineapple barges load at the wharf.

Kaunakakai consists of a few houses and stores about ½ mile inland from the mole, near the mouth of the largest gulch in the vicinity. The village is not easily seen from seaward because of the trees. A tall white radio pole stands about 100 yards northeastward of the inshore end of the mole. A church 100 yards west of the pole is prominent, and silver-colored oil tanks can be seen among trees a short distance inland. Gasoline and a limited amount of provisions may be obtained at Kaunakakai.

Directions.—Approaching Kaunakakai Harbor from either direction keep at least 1½ miles offshore to clear the reef which fringes the coast. When off the entrance steer 35° true (NNE. ⅛ E. mag.) on the line of the range lights and enter the harbor. Vessels can anchor temporarily just outside the entrance, in about 15 fathoms (27.4 m), but there is but little shelter from the trade winds.

A silver-colored water tank is situated 4 miles north-northeast of Kaunakakai, high up on the mountain side. It can be seen from a distance of 10 or 12 miles. About 1 mile westward of Kaunakakai, at the water's edge, is a conspicuous, thick, coconut grove. For a distance of 3 miles westward from Kaunakakai the lowlands extend much farther inland than at any other section of the coast. Here the reef extends nearly 1 mile offshore. The reef has 1 to 3 feet (0.3 to 0.9 m) of water over it, with many coral heads awash at low water. Between Kaunakakai and Kolo the country is bare and rocky and much cut up by small gulches. The sandy beach is lined with algaroba trees. Cattle and honey are produced here.

Kolo Harbor (chart 4121), 10 miles west of Kaunakakai Harbor, is a large pocket in the reef with a narrow entrance channel opening to the southward. It is a privately developed shipping point for pineapples.

There is a depth of 9 feet (2.7 m) in the entrance channel, which is 200 feet wide, and this depth is found in the inner harbor. Buoys, a light, and a lighted range (both lights fixed red) mark the channel, and spar buoys mark the harbor limits. The harbor affords a good anchorage with ample swinging room, but some swell is felt after its full force is broken by the outer reefs. A heavily constructed wharf extends 200 yards offshore into deep water. At the inshore end of this wharf there is a prominent cylindrical aluminum-colored tank. A black tank is situated 200 yards westward of the rear range, and at an elevation of about 125 feet (38 m).

Directions.—Approaching Kolo Harbor from either direction keep at least 1 mile offshore to clear the ½-mile wide reef which fringes the coast. When off the entrance, steer 6° true (N. ½ W. mag.), with the fixed red lights on range ahead. This course passes between the entrance buoys, ⅜ mile offshore; when the channel light is on the starboard beam, haul slowly for the wharf, 500 yards to the northeast. The chart is the guide for anchoring. The channel light (fixed white) is on a red tripod on the east side of the channel and about 300 yards in from the entrance buoys.

Note.—The lighted aids at Kolo are privately maintained, and are shown only when vessels are expected. A moderately heavy swell will cause a heavy surf across the bar; this, together with the current, often makes the channel unsafe.

Westward from Kolo Harbor to Laau Point the coast is low with a narrow sand beach, broken here and there by short stretches of rocky shore. The coral reef gradually becomes narrower until it disappears at Laau Point. **Haleolono Point,** 3 miles west of Kolo, is a conspicuous brown bluff, about 50 feet (15.2 m) high, and extending for ⅛ mile along the water's edge. **Waieli Hill,** 1 mile northeast of Haleolono Point, is 625 feet (190 m) high, and is bare and prominent.

Laau Point, the southwest point of Molokai, is low and rocky, and is marked by Laau Point Light. The 10-fathom (18.3 m) curve around the point is about ½ mile offshore. The prevailing current off Laau Point is northerly, and vessels are cautioned against a set onto the point.

Penguin Bank, an extensive shelf, makes out from the western end of Molokai, in a general west-southwesterly direction for a distance of 28 miles from Laau Point. The bottom on the bank is fairly flat and consists of sand and coral, with soundings of 21 to 30 fathoms (38 to 55 m). Along its northern, western, and southern edges it drops off very abruptly into over 100 fathoms (183 m).

In the vicinity of Laau Point there is a continuous westerly current flowing along the south shore of Molokai and turning sharply to the north as it rounds the point. There is a strong tide rip west and north of the point forming breakers when the wind is northerly. There is a northeast set over the entire bank, which joins the northerly current along the west coast of Molokai. This current is not felt in the deep water west of Penguin Bank, but is apparent at the edge of the bank, when passing inside of the 100-fathom curve. There is no apparent connection between this current and the tides, and the trade winds appear to have little effect upon it, although it appears to be stronger or weaker according as there is a barometric depression north or south of the islands.

Between Laau Point and Ilio Point, a distance of about 8 miles, the west coast of Molokai is bare, low, and rolling, cut up by a few small gulches, and rises gently from the beach, the latter being marked by low bluffs and short stretches of sand beaches.

Papohaku Roadstead (chart 4121), 6 miles northeastward of Paau Point, is an abandoned wire landing formerly used for loading pineapples. The foundations of the loading tower may still be seen on the 60-foot (18.3 m) rocky bluff which projects out 200 yards from the general coast line. The 10-fathom (18.3 m) curve lies about ½ mile offshore in this vicinity.

Ilio Point, the northwesterly point of Molokai, is a low peninsula about 1¼ miles long and ¾ mile wide and rounded at its outer end. Shallow water makes off about ¼ mile northwest of the point. During heavy weather, breakers have been observed about ¼ mile offshore. A hill, 293 feet (89 m) high, is situated ¾ mile in from the end of the point.

From Ilio Point to Cape Halawa, a distance of about 32 miles, the north coast of Molokai has a general easterly trend. It is not surveyed, but is generally bold. There are no harbors or anchorages on this coast affording shelter in all winds. **Kalaupapa** is the only port of call for the local steamer, and with this exception there is practically no traffic along this coast, and no reason for deep-draft vessels to stand close to shore.

Mokio Point, about 3 miles east of Ilio Point, is a low rocky bluff, and is marked by a detached rock close to the point.

About 5 miles eastward of Ilio Point a low precipitous cliff **(Hauakea Pali)** runs inland at right angles to the beach and forms the westerly boundary to the low plain that extends across the island. The seaward end of this cliff looks like a large white sand bank and is the most conspicuous landmark in the vicinity. From this cliff eastward the bluffs along the coast gradually increase in height until they become precipitous cliffs, in some places between 2,000 and 3,000 feet (610 and 914 m) high, and continue to the northeast end of the island. **Paualaia Point,** 9½ miles eastward of Ilio Point, is not prominent.

Makanalua Peninsula, 16 miles eastward of Ilio Point, is low, about 1½ miles wide, and extends out about 2¼ miles northward from the face of a high precipitous cliff. It is marked by Molokai Light, the only light on the north side of the island that is shown continuously. The light structure, a white tower 132 feet (40 m) high, is situated on an 80-foot (24.4 m) grass-covered mound about ¼ mile in from Kahiu Point. There is deep water close to the peninsula, except on the westerly side, where a reef about ¾ mile long extends about ¼ mile offshore, just northward of the landing at Kalaupapa. A steamer, wrecked on this reef, is (1932) situated in an upright position about ⅛ mile offshore.

Kalaupapa, on the western side of Makanalua Peninsula, is the village of the leper settlement which occupies the peninsula. A permit to land is necessary, unless on Government business. The boat landing, which has 2 feet (0.6 m) of water alongside, is somewhat protected by a stone breakwater about 25 yards long. A fixed red light is displayed at the landing once a week when the local steamer calls, or when required. A church, with a white square tower and cross, and numerous houses may be seen among trees in the vicinity of the landing.

Anchorage can be found in about 12 fathoms (21.9 m) ¼ mile off the landing, with the square tower and cross of the church and the landing derrick on range.

Between Makanalua Peninsula and Cape Halawa the country presents a very irregular and jagged appearance, and is more or less covered with vegetation. The precipitous cliffs along the coast are much cut up with deep gulches, bights, and headlands, and except for a few piles of débris at the foot of the cliffs and a few level spots in the mouths of the gulches, no landing can be made.

Kalawao, on the southeast side of Makanalua Peninsula, is part of the leper settlement.

Mokapu Island, 3 miles southeastward of Molokai Light and ¾ mile offshore, is 360 feet (110 m) high. It is the outermost of two islets; the other, **Okala Island,** is 370 feet (113 m) high and close to shore.

Pahu Point, 5 miles southeastward of Molokai Light, is a bold, pyramid-like headland 1,020 feet (311 m) high, which is the seaward end of a sharp ridge extending inland on the west side of a deep gulch. **Mokolea Rock, over which the seas always break, lies ¼ mile off this point.**

Umilehi Point, 1 mile east of Pahu Point, is the double-pointed seaward end of a steep ridge. It is particularly conspicuous, and appears as a small crater with the entire seaward side blown out. **Mokohola Island,** a dark rock 20 feet (6.1 m) high, lies ¼ mile off Umilehi Point.

Pelekunu Landing is on the westerly side of the cove at the mouth of the deep gulch between Pahu and Umilehi Points. It is marked by a small deserted village and an abandoned landing derrick. Neither the village or the derrick are readily seen from offshore. Vessels have anchored in the cove, which affords some protection from the trade winds, but it is unsurveyed and cannot be recommended. The visible rocks and islets off the cove and along the shore to the westward indicate the possibility of submerged rocks, and strangers are cautioned to keep well offshore.

Wailau is on the westerly side of Lepau Point, about 8 miles eastward of Molokai Light. It is at the mouth of a wide gulch, and consists of deserted taro patches and a few houses that are occasionally used by fishermen.

The eastern half of the north coast of Molokai is noted for its rugged scenery and numerous high waterfalls. **Papalaua Falls,** 5 miles westward of Cape Halawa and just southward of **Kikipua Point,** may be seen at the head of a deep gulch. It starts from an elevation of about 2,000 feet (610 m), and in one place has a perpendicular fall of about 500 feet (152 m).

Lamaloa Head, marking the westerly entrance to Halawa Bay, is a precipitous cliff 837 feet (255 m) high.

Halawa Bay, at the northeasterly end of Molokai, is about 1½ miles wide between Cape Halawa and Lamaloa Head and indents the coast about ¾ mile. There is no shelter from the trades, but an indifferent anchorage can be found in 5 fathoms (9.1 m) about ¼ mile off the old landing on the northerly side of the village. The shores of the bay are, for the most part, high cliffs. There are two black, detached rocks close to the southerly shore. Halawa consists of a few houses on the southwesterly side of the bay, in the mouth of a deep gulch that penetrates the island in a westerly direction; a waterfall can be seen about 1 mile up the gulch. About ½ mile eastward of the village, at the waters edge on the South shore, is the conspicuous face of a triangular cliff, about 300 feet (91 m) high. Halawa marks the northeast end of the highway which skirts the southern shore of the island. Steamers no longer call here.

Kaiwi Channel lies between Molokai and Oahu and is about 22 miles wide and clear of obstructions. The trade winds which follow the northerly and southerly shores of Molokai draw across the channel toward Makapuu Head. Little dependence can be placed on the currents except that there is a general northerly current over Penguin Bank.

OAHU (CHART 4110)

the third in size of the islands, lies 22 miles westward of Molokai. It is about 40 miles long between Makapuu Head and Kaena Point and about 26 miles wide between Kahuku Point and Barbers Point. It includes two important mountain systems, and in general presents a more rough and jagged skyline than any of the other islands.

Koolau Range parallels the northeasterly coast for nearly its entire distance. The southeasterly part, between Makapuu Head and a point abreast of Heeia on Kaneohe Bay, is marked on its seaward side by a sheer, rocky cliff, or pali, nearly 2,000 feet (610 m) high in places. Northwestward of this point the cliffs give way to steep, rugged slopes. From offshore the northwesterly half of the range presents a long ridge sloping gradually downward and ending in low bluffs near Kahuku Point. The crest of the ridge and about half the seaward slope is wooded, below which it is grass-covered. The entire range presents a very jagged appearance and is cut up on its inshore side by deep gorges and valleys. The greatest elevation found on this range is **Mount Konahuanui,** which is 3,105 feet (946 m) high. This peak is back of Honolulu, on the east side of Nuuanu Valley, and overlooks the famous **Nuuanu Pali** at the head of the valley. On the easterly side of the range the land is low and rolling, cut up by a few sharp hills, and is under cultivation.

Waianae Mountains parallel the southwesterly coast for nearly the entire distance between Kaena Point and Barbers Point. Several spurs extend from the range toward the shore, forming short valleys. The range is much broken, and there are a number of high peaks. **Mount Kaala,** 4,030 feet (1,228 m) high, has the greatest elevation. Between these two important ranges is a plain which extends from Pearl Harbor to Waialua. This plain is under cultivation, except in the middle, where it is high and rolling and somewhat cut up.

Population.—By the census of 1930, Oahu had 202,887 inhabitants.

Winds.—Between Diamond Head and Honolulu the wind comes offshore during the trades.

Rainfall.—The rainfall in Oahu varies greatly in different localities. The greatest amount is found on the southwesterly side of the Koolau Range opposite Punaluu.

Repairs.—There are machine shops at Honolulu where extensive repairs can be made. See page 62.

Communication with the mainland of the United States and with British Columbia, Australia, and the Orient may be had by several regular lines of steamers. There is a frequent service by coasting steamers around the islands. An excellent airplane service is maintained between the larger islands and Honolulu.

There is communication by telephone to all parts of Oahu, and by radio to the other islands, the mainland of the United States, and the Orient. There is cable communication with San Francisco and also with Manila via Midway and Guam. Radiotelephone service is maintained between the islands and with the mainland of the United States.

Railroads.—There is a railroad that runs westward from Honolulu along the southwesterly and northwesterly coast as far as Kahana, on the northeasterly coast. A branch of this railroad runs to Wahiawa, in the interior of the island.

Highways.—There are good highways in many parts of the island, and transportation can be obtained at most of the towns. A highway skirts the entire coast of the island except for a short distance around Kaena Point.

Currents.—The currents around Oahu are variable in strength and direction, but the general movement of the water along the coast

is westward or northward, the direction being modified by the trend of the coast. From Makapuu Head to Barbers Point, a distance of about 28 miles, the coast has a general westerly trend. It is fringed with coral reefs, varying from ½ to 1 mile in width, for nearly the entire distance between Koko Head and Barbers Point.

Harbors.—Honolulu is the only commercial harbor on the island affording protection in all winds.

SOUTH COAST OF OAHU (CHART 4131)

Makapuu Head, the easternmost point of Oahu, is a bold, barren, rocky headland 642 feet (196 m) high, on which is located Makapu Point Light (occulting white). There is a **radiobeacon** established at this lighthouse which sends out groups of 4 dashes during thick weather and also operates in clear weather the third 15 minutes of each hour from 7:30 p.m. to 6:45 a.m. (Hawaiian time; 157° 30′ west longitude) during clear weather. The radiobeacon towers may be seen near the summit of the head. The seaward side of this headland is a high, dark, sheer precipice, while the inshore side slopes rapidly to the valley which separates it from the mountain range. Makapuu Head is prominent and is generally the landfall for vessels bound from San Francisco to Honolulu. There is deep water close to the easterly end of the head, but between it and a position about abreast of Koko Crater a ledge makes offshore. The sea always breaks close to shore in this vicinity, and the 10-fathom (18.3 m) curve is about ¾ mile from shore. Vessels should give this section of the coast a berth of about 1 mile, taking care to keep in not less than 20 fathoms (37 m). Between Makapuu Head and Koko Crater the coast is low and made up of sand, rock, and shingle.

Koko Crater, about 2 miles southwestward of Makapuu Head, is a sharp, brown cone, about 1,200 feet (366 m) high, and is a prominent landmark for vessels approaching from eastward. Between Koko Crater and Koko Head the coast is rocky and precipitous and somewhat irregular.

Hanauma Bay, just eastward of Koko Head, is about ¼ mile wide and indents the coast about ⅜ mile. It affords good shelter for small craft, but during east-northeast or easterly winds it is very choppy off the entrance. A sand beach, fringed by a coral reef about 150 yards wide, extends across the head of the bay. Directly in back of the beach is a steep bluff, with a short trail leading up to the highway. The bay is a popular bathing beach.

Koko Head, about 2 miles southwestward of Koko Crater, is a bold promontory 644 feet (196 m) high. It has a flat top, with its seaward side precipitous and slopes off rapidly inshore. This headland is partly wooded on the lower slopes on the westerly side, but in general it presents a brown and barren appearance. The top is marked by a small shed. **Kawaihoa Point,** the southwesterly end of Koko Head, forms the southeasterly point of Maunalua Bay. There is deep water close to the southern side of Koko Head.

Maunalua Bay is an open bight on the westerly side of Koko Head. A coral reef fringes the shore, the water deepening gradually outside of the reef. Shoal water extends ¾ mile from the head of the bay, but there is an opening in the reef where small boats may

pass to the sandy beach. Outside the 3-fathom (5.5 m) curve the bottom is regular, and vessels can anchor anywhere during ordinary weather in 8 or 10 fathoms (14.6 or 18.3 m). The shore of the bay is low and wooded. A narrow strip of lowland separates the head of the bay and Kuapa Pond. A radio mast may be seen at the water's edge 3 miles west of Koko Head.

Diamond Head (Leahi), about 6 miles westward of Koko Head, is an extinct crater, 761 feet (232 m) high, on the southerly side of which is located Diamond Head Lighthouse. The slopes and the top of the crater are bare and brown, but at its base it is thickly wooded. The slopes are steep, and on the seaward side there is a narrow bench about 100 feet (30 m) above the water, which shows a broken bluff line to seaward. The reef extends for ⅜ mile off Diamond Head Light and is marked off its outer end by Diamond Head Reef lighted buoy, moored in 15 fathoms (27.4 m), ⅝ mile 213° true (SSW. mag.) from the lighthouse.

Kupikipikio Point (Black Point) is a small, dark, rocky point 1 mile east of Diamond Head Light, and is marked by two flagstaffs and several houses among trees.

Between Diamond Head and Honolulu the coast is low and wooded, with a continuous coral reef extending offshore ¼ to ½ mile. A large, white building is located at the water's edge about 1 mile northwestward of Diamond Head Light.

Waikiki Beach, a famous bathing beach, is about 1½ miles northwestward of Diamond Head. The large, pink-colored Royal Hawaiian Hotel and the gray-colored Moana Hotel are situated close together near the shore and are very prominent. The natatorium, on the shore ¾ mile southward of the hotels, is also prominent.

HONOLULU HARBOR (CHART 4109)

is the most important port in the Hawaiian Islands. It lies on the south side of Oahu, 15 miles westward of Makapuu Head and 13 miles eastward of Barbers Point. The entrance through a coral reef is a channel ⅝ mile long and 400 feet wide, and the harbor is ½ mile long and 300 to 500 yards wide. Both the channel and the harbor have been dredged to a depth of 35 feet (10.7 m). The channel is well marked by lighted buoys and a lighted range (both range lights fixed red), making the harbor easy of access for steamers both day and night.

There are depths of 30 to 40 feet (9.1 to 12.2 m) alongside the principal wharves. The depths at some of the wharves are subject to shoaling, and these shoal places are removed from time to time by dredging. A canal, 400 feet (122 m) wide, connects Honolulu Harbor and Kapalama Basin, ½ mile west of the harbor. In 1932 this canal was being dredged to a depth of 35 feet (10.7 m).

Honolulu is the capital of the islands. It is a city with all modern improvements, and in 1930 had 137,582 inhabitants. The city is located on the low plain that lies at the foot of the Koolau Range. There is a large foreign and coastwise trade.

Prominent features.—The most prominent objects in Honolulu from offshore are Aloha tower on Piers 9 and 10, east side of harbor; the tall, twin stacks of the electric plant close to the east side of

the harbor; the tall incinerator stack on the shore, ⅝ mile eastward of the harbor entrance; a water tank near the head of the harbor. At night, between 6 p.m. and midnight, a vertical red neon light on a radio tower is very prominent. The neon light is over 100 feet (30 m) high and is located 1,285 yards 112° true (E. by S. mag.) from Honolulu Harbor Light. It is visible about 20 miles to southward.

Aloha Tower is about 190 feet (58 m) high and about 40 feet (12.2 m) square. Honolulu Harbor Light is located on the top of this tower. The features of the tower include an electric siren, a clock with 12-foot (3.7 m) faces showing on all four sides, and a pilot's lookout. The stacks of the electric plant are of light-gray concrete, 221 feet (67 m) high, 87 feet (26.5 m) between centers, and are in line on approximately a NW. ½ N. bearing. The water tank is 140 feet (43 m) high and resembles a pineapple in shape and color.

The *Fort Armstrong flagstaff*, at the easterly side of the harbor entrance, is fairly prominent, as is also the tall, sharp spire of the Central Union Church, 2 miles east of the harbor. Kamehameha School buildings are located on the 500-foot (152 m) level about 2 miles north of the harbor; they are flat, tan-colored, and may be seen from many miles seaward.

Punchbowl is a flat-topped, conical hill, 498 feet (152 m) high, lying immediately back of the city. **Mount Tantalus**, about 2½ miles northeastward of Punchbowl, is a rounded peak 2,013 feet (613 m) high and is heavily wooded at its summit. **Mount Konahuanui**, about 2 miles northeastward of Mount Tantalus, is 3,105 feet (946 m) high and is the summit of the Koolau Range. It consists of double peaks which, when seen from southward of Honolulu, appear to be about the same height. **Mount Lanihuli**, about 1½ miles west-northwestward of Mount Konahuanui, is dome-shaped, with a flat summit, and is 2,775 feet (846 m) high. **Mount Kaala**, about 4 miles north-northeastward of Waianae, is a flat-topped peak, the highest of the Waianae Mountains, and is 4,030 feet (1,228 m) high.

Pilotage is not compulsory, but vessels are required to pay half pilotage when a pilot is not taken, unless they have a coasting license. Pilots come out in small boats and meet vessels just outside the entrance. See appendix for Pilot Rules and Regulations.

Towboats can be had. Regular rates have been adopted, but for towing vessels from outside the pilot limits, an agreement is made between the vessel and the towboat.

Anchorage.—Vessels sometimes anchor outside of the harbor on either side of the entrance in 8 to 13 fathoms (14.6 to 23.8 m), sandy or coral bottom. The shoaling is more gradual and the depths more moderate on the west side of the entrance. The water shoals rapidly toward the reef, and vessels should approach the desired depths with caution. This anchorage is exposed to all southerly winds. There is not sufficient swinging room for large vessels to anchor within the harbor.

Wharves.—There are numerous modern wharves with from 30 to 40 feet (9.1 to 12.2 m) of water alongside.

Harbor regulations are enforced by the harbor master. The harbor master should be informed ahead of time as to the date of a vessel's arrival, so that arrangements can be made for berthing and fueling.

Quarantine.—Vessels are boarded outside by surgeons of the Public Health Service at Honolulu, from whom full information can be obtained concerning quarantine and sanitary regulations. Vessels must not enter the harbor until boarded outside by the quarantine officer. The quarantine station is on the west side of the harbor (Sand Island), but the offices of the Public Health Service are in the Federal building.

Marine Hospital.—There are officers of the Public Health Service at Honolulu, to whom application can be made for medical relief, the office being in the Federal Building.

Supplies.—Coal and fuel oil can be obtained. Water can be obtained alongside the wharves. Provisions and ship chandlers' stores are to be had in the city.

Repairs.—There are machine shops at Honolulu where extensive repairs can be made. There are three floating dry docks, having keel-block lengths of 352 feet (107 m), 165 feet (50 m), and 53 feet (16.2 m), respectively. The large dry dock has a dead-weight capacity of 4,500 tons, and has lifted vessels over 400 feet (122 m) long. Divers may be obtained.

Time Service.—Vessels can obtain chronometer comparisons and geographical information relative to the islands at the Government survey office. See page 6 for time signals by radio.

A Coast and Geodetic field station is located in Aloha Tower. Charts and publications of the Service may be inspected or purchased here.

DIRECTIONS

The harbor is easy of access for steamers, both day and night. The trades generally blow offshore, and sailing vessels have to tow in. *Caution:* When approaching Honolulu Harbor at night from the westward, do not mistake the lights of settlements between Barbers Point and Kalihi entrance for the lights of Honolulu. The tall, conspicuous, red neon light in Honolulu is a good leading mark from the westward, when lighted.

When approaching Diamond Head from the southeastward, the many lights of Kaimuki district may be seen extending up the slopes to the northward of Diamond Head Crater. These lights are seen from a distance of 15 or 20 miles, and the red neon light of a theater in this group must not be mistaken for the vertical neon light near Honolulu Harbor, previously mentioned. The following directions lead in a least depth of about 35 feet (10.7 m).

From eastward, pass 1½ miles or more south-southeastward and 1 mile or more south-southwestward of the Diamond Head Lighthouse, passing 600 yards or more south of the lighted buoy (flashing red) off Diamond Head, and steer for Mount Kaala, the highest peak of the Waianae Mountains, on a 312° true (NW. by W. ¼ W. mag.) course for about 3¾ miles until Outside Entrance lighted buoy No. 2 (flashing white) is on the starboard beam, distant 300 yards or more. Continue the 312° course until ¼ mile past this buoy, then haul

to the northward and enter Honolulu Channel, passing between Entrance lighted buoys No. 1 (flashing white) and No 4 (flashing red) on a 29½° true (N. by E. ⅝ E. mag.) course, with the channel range lights on line ahead. Continue on the range until past lighted buoy No. 5 (flashing white) and then haul northward, passing along the wharves.

From westward, passing southward of Barbers Point Reef lighted buoy (flashing white) and 1½ miles or more southward of Barbers Point Light, vessels can at night steer for Diamond Head Light on any bearing northward of 93° true (E. ¾ N. mag.), or in the daytime steer on any bearing northward of 87°30′ true (ENE. ¾ E. mag.) for Koko Crater. Keep on or south of these bearing lines. The distance from Barbers Point to the entrance is 13 miles, and either course will lead clear until off the entrance of the harbor. Then follow the directions in the preceding paragraph.

The following descriptions and list of ranges may be found useful in swinging ship off Honolulu Harbor:

Fort Armstrong Flagstaff: A tall white flagstaff situated close to shore near Pier No. 1, at the southeast side of the entrance to Honolulu Harbor.

Cupola, New City Hall: The white, square tower of the new city hall, on King Street. The tower has a red tile roof, and is the whitest of the several towers in Honolulu.

Aloha Tower: The 190-foot (58 m) tower, about 40 feet (12.2 m) square, on Piers Nos. 9 and 10, on the east side of Honolulu Harbor, the most prominent object in the city.

Incinerator Stack: The lone, 130-foot (40 m) concrete stack at the water's edge, ½ mile southeast of the easterly entrance point to the harbor and just southwestward of Kewalo Basin.

Compass Ranges, off Honolulu Harbor

Front object	Rear object	True bearing		Magnetic bearing	
		°	′	°	′
Fort Armstrong flagstaff	Cupola, new city hall	53	47	42	47
Fort Armstrong flagstaff	Aloha tower	8	28	357	28
Incinerator stack	Cupola, new city hall	13	33	2	33
Incinerator stack	Aloha tower	341	08	330	08

Kewalo Basin, ⅝ mile eastward of Honolulu Harbor entrance and just eastward of the tall incinerator stack, is the small yacht basin of the city. The short channel through the coral reef is only about 50 yards wide but is marked on either side by buoys and beacons. About 15 feet (4.6 m) can be carried through the channel and depths of from 20 to 27 feet (6.1 to 8.2 m) will be found alongside the wharf at the northwest side of the basin. A lighted range (both lights fixed green) leads through the channel on a 31° true (N. by E. ¾ E. mag.) course. The dredged basin extends about 300 yards eastward of the wharf, and affords a fine anchorage for sampans and launches in from 9 to 18 feet (2.7 to 5.5 m).

The water front for 1¼ miles eastward of Kewalo Basin is (1932) being improved with a city park. The dredging operations for the fill have made a small-boat channel, 1 mile long, along the bulkhead of the park. Boats now have an inside passage between Kewalo Basin and the small boat landing near the mouth of **Ala Wai Canal.** The coral reef extends from ⅜ to ½ mile offshore in this vicinity.

HONOLULU TO BARBERS POINT (CHARTS 4132, 4133)

Between Honolulu and Barbers Point the coast is a low, white, sandy beach covered with trees. Just westward of Honolulu there is an extensive inlet, much of which is bare at low water. This entire stretch of coast is fringed by a coral reef over which the sea generally breaks. There are openings in the reef at Honolulu and Kalihi, but it is possible that landings might be made at other places in smooth weather. The country back of the coast is low and covered with sugarcane; several large mills can be seen, the most prominent of which is the one at Ewa. This mill is large and around it are grouped several small, white buildings.

Kalihi Entrance, about 1½ miles westward of Honolulu, is a narrow channel through the reef, used only by boats.

An airplane landing field is located near the north shore of **Keehi Lagoon,** 3 miles westward of Honolulu. It is marked by two large hangers.

Barbers Point is a low, flat coral plain covered with algaroba trees and is marked by Barbers Point Lighthouse, a white conical tower showing a group flashing white light. The coast curves gradually and shows a white, sandy beach with dark rocks here and there. The land is level back to the foothills of the Waianae Mountains, which are about 3 miles from shore. The slopes of the hills are steep and partly covered with vegetation, the bare red soil showing in places and giving them a noticeable reddish appearance. The reef extends ⅝ mile off Barbers Point. Barbers Point Reef lighted buoy (flashing white) is moored in 8 fathoms (14.6 m) 1¼ miles south-southeastward of Barbers Point Light.

SOUTHWEST COAST OF OAHU (CHART 4110)

From Barbers Point to Kaena Point, a distance of about 19½ miles, the southwest coast of Oahu has a general northwesterly trend. It is in most part bold, but there are a few outlying dangers, which will be avoided by giving the coast a berth of at least 1½ miles. The coast consists of alternating ledges of rock and stretches of white sand beaches. The land near the coast is in most part high. Spurs extend to the coast from the Waianae Mountains, forming valleys. The valleys are heavily wooded, but the mountains are rocky and bare. There are no harbors or anchorages affording shelter in all winds. A shoal between ½ and ¾ mile wide fringes the coast from Barbers Point to Kahe Point.

The Oahu railroad follows this coast, close to the shore, from a point 3 miles northwestward of Barbers Point to Kaena Point.

Kahe Point, 3½ miles northwestward of Barbers Point, is the seaward end of a mountain spur.

Nanakuli, 5½ miles northward of Barbers Point, consists of a group of small homesteads near the shore, and is marked by two silver-colored water tanks about 1 mile inland.

Puuhulu Ridge, 8½ miles northwestward of Kahe Point, is a narrow, rocky, barren ridge, 1½ miles long, located at the southerly one of the two important projecting points of this coast, and is the most conspicuous landmark in this vicinity. The westerly end of the hill is close to the shore, has an elevation of 856 feet (261 m), and is precipitous on its seaward side.

Mailiilii Hill, about 2 miles northward of Puuhulu Hill, is a narrow, rocky ridge 729 feet (222 m) high, standing near the shore and approximately at right angles with it.

Kaneilio Point is a small, low point on the southerly side of Pokai Bay. Between Mailiilii Hill and Kaneilio Point and ¼ mile inland, the light-colored buildngs of a lime kiln show up conspicuously against the dark background. The lime kiln is an excellent landmark from the westward and northwestward. Between Puuhulu Ridge and Kaneilio Point shoals extend about ½ mile offshore in places.

Pokai Bay, about 1 mile northwestward of Mailiilii Hill, is a small indentation in the coast, on the shore of which the town of Waianae is located. Most of the town is hidden by the trees, but the red-brick stack of the sugar mill is prominent. **Waianae** is on the railroad and highway, and there is no traffic by water. Landing can generally be made on the short stretches of sand beach except during southerly winds. *Approaching the bay,* vessels should head for the mill stack at Waianae on an 80° true (ENE. ⅛ E. mag.) course, and anchor about ½ mile offshore in 8 to 10 fathoms (14.6 to 18.3 m). Shoal water extends about ¼ mile off the shores of the bay. The red tank at the railroad station is located close to shore on the southeast side of the bay.

Waianae plantation occupies the deep valley which lies between Puuhulu Hill and Lahilahi Point. This valley extends back into the island about 4 miles and is the largest one on this side of the Waianae Mountains. The broken ridge which makes down to Paheehee Hill divides the valley in two. **Paheehee Hill** is 652 feet (199 m) high and is situated ¾ mile east of the mill stack at Waianae.

Lahilahi Point, 1½ miles northwestward of Waianae, is a detached, steep ridge of dark rock 234 feet (71 m) high, which forms a narrow point projecting seaward about ¼ mile. It is conspicuous and appears as an islet from a distance.

Kepuhi Point, about 1⅛ miles northwestward of Lahilahi Point, marks the seaward end of a bold, rocky mountain spur, which comes to within a few hundred yards of shore. At the base of the bluff there is a low, narrow strip of thickly wooded land. From Kepuhi Point to Makua village the coast trends north.

Makua village, 3 miles northward of Kepuhi Point, marks the northerly end of the coast highway. A few houses can be seen among the trees near the shore. There is a sand beach here where boats can land when the sea is smooth. Vessels can anchor about ¼ mile offshore in 4 to 6 fathoms (7.3 to 11 m). Back of the village is a small, crater-shaped valley. Between Makua village and Kaena Point the coast trends northwesterly and is rocky, except for one short sand beach. The mountains rise steeply from the beach.

Kaena Point, the westernmost point of Oahu, is a low, rocky point extending out a few hundred yards from the foot of Kuaokala Ridge. It is marked by Kaena Point Light (flashing white) on a white skeleton tower. A small, boxlike building on the point is often seen before the light structure is picked up. There are two or three noticeable sand dunes on the point. Just off the end of the point are several low, jagged rocks, over which the sea washes, and the sea breaks offshore to a distance of about ⅜ mile. West of the point the 10-fathom (18.3 m) curve lies ¾ mile offshore.

NORTHWEST COAST OF OAHU (CHART 4110)

Kuaokala Ridge is high and its seaward end breaks off rather abruptly. From Kaena Point to Kahuku Point, a distance of about 18½ miles, the northwest coast of Oahu has a general easterly trend as far as Kaiaka Bay, and thence northeasterly to Kahuku Point. It is fringed with a reef for its entire distance, but all dangers will be avoided by giving the coast a berth of at least 1 mile. The coast consists of alternating ledges of rock and stretches of white sand beaches. There are no harbors or anchorages affording shelter in all winds. About 6 miles eastward of Kaena Point and ½ mile offshore there is a rock awash. The breaker or the rock itself is always visible. **Mokuleia village** is 6½ miles eastward of Kaena Point.

Kaiaka Bay, 9 miles eastward of Kaena Point, is a small indentation in the coast just southwestward of a small point of the same name. **Kaukonahua River** enters this bay. Coral reefs extend ⅝ mile off the shores of the bay. About ¾ mile west of the river mouth, a narrow, deep channel extends through the coral to the beach.

Waialua Bay, 10 miles eastward of Kaena Point, is a small indentation at the bend near the middle of the northwest coast of Oahu. The bay is of no commercial importance, although it is a popular bathing beach. Its shores consist of low, black rock, with sand patches in the bights, and a fringe of large algaroba trees. The back country is low, and slopes gently to a tableland with mountain ranges on either side. A small boat channel leads through the coral reefs to a landing on the south shore of the bay. A glass-bottom excursion boat makes regular trips around the coral beds.

Prominent objects in the vicinity of Waialua are the yellow church spire and tall white stack with a mill beside it, in the village of **Haleiwa,** ¼ mile inland from the head of the bay. Two silver-colored gasoline tanks may be seen among the trees on the east side of the bay. One mile northeastward of Waialua Bay and ⅜ mile inland is a pumping station with a large light-colored stack. Back of the pumping station, on the brow of the hill, is a group of cottages and a red-roofed church with spire.

Between Wailua and Kahuku Point there is a narrow strip of lowland along the coast, back of which is a tableland covered with vegetation, with steep grassy slopes facing the sea. These slopes are cut up in places by deep gorges. The highway and railroad lie close together along this section of the coast, and are near the shore.

Waimea Bay, 3½ miles northeastward of Waialua Bay, is a small indentation in the coast at the mouth of a deep gorge which divides into two branches some distance up. The bay affords little shelter, and a landing can be made only in very smooth weather. It is of no commercial importance. When close in, a highway bridge can be seen across the stream that flows down the gorge. There are several scattered buildings on the northerly side of the bay. There are two large rock crushers on the northeastern point of the bay; the southerly one, a tall, square cement tower with a red-tile roof, is the most conspicuous object along this coast. There is a wide sand beach at the head of the bay, but on both sides of the entrance the shore consists of low, rocky ledges. Off the southerly entrance point are two

ragged masses of black rock, with deep water close-to on the offshore side. The outer rock is called **Wananapaoa Islet.** Near the northerly entrance point are some submerged rocks, which are generally marked by breakers.

Vessels can stand in for the middle of Waimea Bay and anchor about ¼ mile offshore in 9 or 10 fathoms (16.5 or 18.3 m), sandy bottom, with the mouth of the river bearing 101° true (E. mag.).

Waialee Industrial School is a group of large, conspicuous, tan-colored buildings about 4 miles northeastward of Waimea Bay. The buildings are situated at the foot of a bluff, and a few hundred yards in from the shore. On the western side of the group is a short chimney.

Kahuku Point, the northernmost point of Oahu, is low, covered with sand dunes partly covered with vegetation, and has a few scattered trees. It is marked by a prominent, tall, yellow stack, ½ mile in from the end of the point. A series of tall, black, radio masts are grouped around the stack. The coast rounds gradually at this point, and there are a number of small black rocks close inshore. The land rises gently from the low bluffs at the point to the mountains. Off this point the 10-fathom (18.3 m) curve draws in to about ⅜ mile from shore, and in the daytime the breakers afford sufficient warning to guide clear of all dangers. At night, however, great care must be used, as it is difficult to locate the point on account of the low land and the absence of any aids to navigation.

NORTHEAST COAST OF OAHU (CHART 4110)

From Kahuku Point to Makapuu Head, a distance of about 31 miles, the northeast coast of Oahu has a general southeasterly trend It is fringed with coral reefs for nearly its entire distance. Between Kahuku Point and Kaneohe Bay the beach is for the most part low and sandy, with black rocks showing in places. There is a narrow strip of low, cultivated land between the beach and the foot of the mountains, which narrows as Kaneohe Bay is approached. The highway parallels the coast as far as Kaneohe Bay and the railroad as far as Kahana Bay, and numerous villages can be seen from offshore.

Kahuku mill stack, 2½ miles southeastward of Kahuku Point and about ½ mile inland, is prominent. A large grove of ironwood trees extends ¾ mile southeastward from the mill.

Laie Bay, 5 miles southeastward of Kahuku Point and 1 mile northwestward of Laie Point, is a narrow opening in the reef, with depths of 3 to 7 fathoms (5.5 to 12.8 m), where small craft with local knowledge can find shelter and make a landing. There are three small, low islets in this vicinity, the middle one, **Mokuauia Island,** lies about ¼ mile offshore and is the largest. The entrance of the bay is near the south side of Mokuauia Island on a 214° true (SSW. mag) course for the Mormon Church (large and prominent, with cupola). Strangers should not attempt to enter without a pilot. **Kihewa Islet** lies 1½ miles northward of Laie Point and ¾ mile offshore. **Polemoku Rock** lies ⅝ mile north of Laie Point and ¾ mile offshore.

Laie Point, 5½ miles southeastward of Kahuku Point, is narrow, low, bare, and has a rocky beach. Just off its end are two small,

flat, rocky islets (**Kukuihoolua Islet** and **Mokualai Islet**). Vessels should pass at least ½ mile off these islets.

Kaipapau Hill, 2 miles southward of Laie Point and ⅝ mile inland is 632 feet (193 m) high, and has a pyramid-shaped, grass-covered top.

Hauula Park, 2½ miles southward of Laie Point, is marked by a flagpole and a public bathhouse.

Punaluu village, 4 miles southward of Laie Point, is marked by two small churches near the beach and ⅛ mile apart. The churches are among trees and are not readily seen from seaward. There are several large beach homes among the trees in this vicinity.

Kahana Bay, 6½ miles southeastward of Laie Bay, is a long, narrow opening in the reef lying at the mouth of a valley, where small craft with local knowledge can find shelter. Kahana village, partly hidden by the trees, is at the head of the bay. The breakers on both sides of the bay are the only guide for entering. **Punaluu Point** marks the northern side of the bay, and **Mahie Point** the southern side. The 10-fathom (18.3 m) curve lies 1⅛ miles off these points. Kahana Bay marks the southern end of the railroad along this coast. About 3 miles southeastward of Kahana Bay and along the highway is the gray, square, chimney of a former sugar mill. About ⅜ mile northward of this chimney is a small, privately owned boat landing.

Mokolii Island, ⅜ mile off Kualoa Point and 4 miles southeastward of Kahana Bay, is a conspicuous, conical islet with two coconut trees on its inshore side.

Kaneohe Bay, 4 miles southeastward of Kahana Bay and just northwestward of Mokapu Peninsula, is about 5 miles wide between Kualoa Point and Pyramid Rock and indents the coast about 2 miles. It is full of reefs and shoals with depths of 7 to 8 fathoms (12.8 to 14.6 m) between. There is an entrance near the northwesterly end of the bay and one near the southeasterly end, and with local knowledge it is possible to take 10 feet (3 m) through the former and 8 feet (2.4 m) through the latter. In heavy trades the sea breaks across both entrances. Strangers should not attempt to enter without a pilot. There are several small, low islets in the bay; the outermost (**Kapapa**) is 1¾ miles off the eastern side, and near the center of the bay. Several villages and small-boat landings are scattered along the shores of the bay. There are three tall radio towers at **Heeia,** on the southwestern side of the bay. The boat landing of a yacht club is situated a short distance southward of the towers. The village of **Kaneohe** is about 1½ miles southeastward of Heeia. A glass-bottom excursion boat makes regular trips around the coral beds.

Pyramid Rock, the northwesterly point of Mokapu Peninsula, is black and has a sharp summit.

Mokapu Peninsula, about 19 miles southeastward of Kahuku Point and 10 miles northwestward of Makapuu Head, is a prominent landmark with a greatest elevation of 695 feet (212 m). **Ulupau Head,** at the northeasterly end of the Peninsula, is a rocky headland, part of the rim of an old crater. **Mokumanu Islands,** lying ¾ mile northward of the head, are two small islands, about 200 feet (61 m) high, with vertical sides. The passage southward of the islands has a depth of about 5 fathoms (9.1 m) in mid-channel, but it should not be used by strangers. Between Mokapu Peninsula and

Makapuu Head the beach is for the most part low and sandy with black rocks showing in places. There is a narrow strip of cultivated land between the beach and the foot of the sheer, rocky cliffs, or pali. These sheer cliffs are a characteristic of the mountains from a point abreast of Kaneohe Bay to Makapuu Head. The mountain range gradually draws nearer to the coast as Makapuu Head is approached.

Kailua Bay, southeastward of Ulupau Head, is an open bight affording no shelter from the trades. The beach at the head of the bay is sandy, and is marked by a public bathhouse. Shoal water extends 7/8 mile off the shores of the bay. Between Kailua and Waimanalo Bays may be seen a group of grass-covered hills near the beach.

Mokolea Rock, lying about 1 mile offshore in the northerly part of Kailua Bay, is a small black rock, about 20 feet (6.1 m) high, with 5 to 8 fathoms (9.1 to 14.6 m) around it.

Alala Point is on the southern side of Kailua Bay, and is a low bluff with a white stone monument 25 feet (7.6 m) high which resembles a lighthouse.

Mokulua Islands, the northerly one 206 feet (63 m) high and the southerly one 182 feet (55 m) high, are steep, rocky islets with grass-covered slopes, lying about 3/4 mile offshore and midway between Alala and Wailea Points. Westward of the islets is an extensive reef, and between the reef and the mainland is a small boat passage leading to privately owned boat landings.

Waimanalo Bay, lying between Wailea Point and Makapuu Head, affords shelter in all weather for small craft behind the barrier reef which parallels the coast in this vicinity. The entrance is in the northwesterly part of the bay, with a least depth of 12 feet (3.7 m) over the bar and 10 feet (3 m) inside. During strong trades the entrance is closed by breakers. There is a small wharf at a place called **Waimanalo Landing,** in the southern part of the bay, but it is seldom used. Waimanalo Plantation settlement is situated 1 mile inland from the bay, and is marked by the mill and tall stack. There is a shallow boat passage along the beach between Waimanalo Bay and Kailua Bay.

The reef, which extends 1 1/4 miles off the northern shore of Waimanalo Bay, gradually trends inshore until it disappears near Makapuu Point.

Manana Island, 359 feet (109 m) high, lies 1 mile north-northwestward of Makapuu Point Lighthouse. It is part of an old crater and consists of a lighter shade of rock than any in the vicinity. Its sides are bluff, except on the westerly side, where there is a short sloping point. There is deep water close-to on the northeasterly side of the island. There is a depth of about 4 fathoms (7.3 m) between Manana Island and the mainland, but it should not be attempted by strangers.

Kaohikaipu Island is a flat, black mass of rock, about 70 feet (21.3 m) high, lying about midway between Manana Island and Makapuu Head. A double rock about 10 feet (3 m) high, lies 200 yards northeastward of the islands. In a heavy swell the sea breaks about 100 yards outside of the rock. A small black rock, just showing above the water, lies about 170 yards southwestward of the island. There is a depth of about 5 fathoms (9.1 m) between Manana and Kaohikaipu Islands, but owing to the reefs which make off

from both islands, strangers should not attempt it. There is a good water in the bight between Kaohikaipu Island and Makapuu Head, but vessels should not attempt to pass through between the island and the mainland.

Kauai (Ieiewaho) Channel, between Oahu and Kauai, is about 64 miles wide and clear of obstructions. During trade winds the current generally sets westward across the channel and when Kauai is reached it divides, part following around the northerly side of the island and another part around the southerly side. During the first calms after strong trades the current often sets eastward. Strong southerly or southwesterly winds cause the current to set in the opposite direction to that produced by the trades.

KAUAI (CHART 4117)

the fourth in size of the islands, lies about 64 miles west-northwestward of Oahu. It is nearly circular in shape, about 23 miles in diameter, and slopes from the central mountain mass of **Kawaikini**, which has a greatest elevation of 5,170 feet (1,576 m). On the westerly and northerly sides the mountains slope in steep and jagged ridges, and on the easterly and southerly sides in gentle slopes, which are much cut up by gulches. There are few outlying dangers, and by giving the coast a berth of 2 miles all danger will be avoided. The peaks and highlands are nearly always clouded over, making the island itself difficult to see from any great distance.

Population.—By the census of 1930, Kauai had a population of 35,806 inhabitants.

Winds.—The trade winds divide on the easterly side of Kauai, part following the northerly and part the southerly coasts, uniting again some distance west of the island. On the west side, between Mana and Mahaka Points, calm or light variable airs prevail. A moderate southwest wind is sometimes felt at Waimea Anchorage, while a strong east wind is blowing about 2 miles offshore. Along the northerly and southerly shores, the early morning trade wind is usually light until about 9 a.m.

Rainfall.—The weather side of the island is noted for its frequent heavy rainfalls, which reach a maximum yearly average of about 430 inches in the vicinity of **Mount Waialeale.** The lower slopes, however, have much less rain, and along the southerly side the fall seldom exceeds 20 inches.

Anchorages are numerous, but none of them afford shelter in all weather except Nawiliwili Harbor, which is restricted in size.

Supplies.—General supplies, ice, and lumber, can be obtained at Lihue (the county seat), Port Allen, and Waimea. There are no large ship chandler's stores. Fresh water for vessels may be obtained at Ahukini and Nawiliwili.

Repairs.—The plantation and railroad machine shops can handle some repairs. There are no dry docks.

Communication.—A biweekly freight and passenger steamer service is maintained between the island and Honolulu. Several other lines of steamers call regularly at Port Allen, Nawiliwili, and Ahukini. There is a regular airplane service with Honolulu. There is telephone communication to all parts of the island, and radiotelephone service with the other islands and with the mainland.

A good highway skirts the island except for the northwest side between Haena and Nohili Points, where there are no roads whatever.

Currents.—The currents generally follow the winds, though frequently setting in the opposite direction during the first calms after strong trades.

Nawiliwili Bay (chart 4111), on the southeast side of Kauai, is about ¾ mile wide between Ninini Point and Carter Point and indents the coast about ⅞ mile. The shore consists of rocky bluffs, except at the mouth of Huleia River and in the northerly part near Nawiliwili village. The jagged, mountainous coast extending southwestward from Carter and Kawai Points, is in marked contrast with the lowlands of Huleia River, on the southwest side of the bay and offers a means of fixing the entrance from well offshore. The breakwater extending from Carter Point northward over South Reef and the sea wall on the north side of the bay form the only protected harbor on the island. The eastern portion of the harbor has been dredged to a depth of 35 feet (10.7 m), the dredge area being marked on the southerly and westerly sides by lighted buoys. The end of the breakwater is marked by a flashing white light and the end of the sea wall by a flashing red light. A reflector buoy marks the limit of shoal water off the end of the sea wall.

The territorial wharf, on the north side of the harbor, had a depth of 27 feet (8.2 m) in 1932, at which time the dredged area was being extended northwestward with a view to increasing the length of the wharf to 1,000 feet (305 m). Vessels drop anchor well out from the wharf before going alongside, as there is but little maneuvering room. There is a large warehouse on the wharf which can be seen from a considerable distance offshore.

The chart is the best guide for entering the harbor; the reverse turn first around the breakwater then around the sea wall, which must be made when approaching the wharf, is difficult for large vessels during strong winds.

There is a harbor master, pilot, and a quarantine officer. Pilotage is advisable but not compulsory. There are hotels, a hospital, and good general stores in Lihue, 2 miles inland. Fresh water is available at the wharf, also gasoline and fuel oil. A 200-horsepower towboat, stationed at Ahukini, is available on short notice.

Anchorage with some protection from the trades may be selected anywhere between Ninini and Kukii Points, with the chart as a guide. Vessels in the lee of the breakwater may have to leave their anchorage on steamer days to clear the channel to the wharf.

Nawiliwili Village consists of a few buildings at the head of the arm of the bay between Kukii Point and the sea wall. The bight, which is used by small boats only, has a sand and coral bottom, and a sand beach at its head.

Ninini Point is low, flat, and rocky, and is marked by Nawiliwili Harbor Light (flashing white), the reflections of which are frequently seen from vessels 40 miles away. The back country is covered with cane fields.

Kukii Point, ¾ mile westward of Ninini Point, is a high bluff with a low rocky shelf at the base on which is a flashing red light. The point, and the north end of the breakwater, 360 yards southward, mark the entrance to the harbor.

Huleia River, at the southwesterly end of the bay, is navigable for boats to the first footbridge, about 2 miles above the entrance, where a dam obstructs passage. Small boats find excellent anchorage in the river, except when the sand bar at the mouth closes the entrance.

Mokole (Carter) Point is rocky and rises rapidly to a peak 786 feet (240 m) high. The mountain spur which makes inland from here rises to dome-shaped **Haupu Peak,** 2,280 feet (695 m) high, which is the most prominent landmark in southeastern Kauai.

Kawai Point, ½ mile southward of Mokole Point, is a bold, rocky headland 525 feet (160 m) high. It is very irregular and jagged in appearance.

Kawelikoa Point, 3 miles southwestward of Kawai Point, is a dark, rocky, headland, 687 feet (209 m) high, at the end of a ridge making northward to Haupu Peak. From a point about 2 miles northeastward of Makahuena Point to Hanapepe Bay the coast is made up of low bluffs and beaches, the country is almost all under cultivation, and in places the cane fields extend well up the mountains.

Makahuena Point, the southeast point of Kauai, is low and flat and has a rocky shore line with bluffs from 20 to 50 feet (6.1 to 15.2 m) in height. The land near the point is sandy and rolling, and there are short stretches of sand beach both northeast and west of the point, which is marked by a flashing white light. There is a depth of 8 fathoms (14.6 m) ½ mile southeast by south from the point from which the depths shoal gradually to the shore. Between this point and Koloa Landing there are several reefs extending about 300 yards out from the shore.

Koloa mill stack, 2 miles inland from the point, is conspicuous from all along this coast, except for a short distance in which it is hidden by **Paa Cones.**

Koloa Landing, 1½ miles west of Makahuena Point, is marked by a small open shed by the side of a walled-in landing slip. It is a small indentation affording fair protection in trade weather but is entirely exposed to the south. Anchorage with rocky bottom can be obtained in 12 fathoms (21.9 m) about 400 yards southward from the landing.

Kuhio Park is about ½ mile west of Koloa Landing and on the shore road. A tall, conspicuous flagpole marks the park. There are several beach houses between Koloa Landing and the park.

Kukuiula Bay, 1¼ miles west of Koloa Landing, is 150 yards wide and indents the shore about 300 yards. It affords considerable protection for small boats except in southerly winds. Rocks piled on the reef extending southeast from the bay form a breakwater. The bay is used by a number of small fishing sampans. About ¼ mile west of this landing is a salt-water spout, locally known as the "*Spouting Horn*", which is quite active when the seas are heavy.

Lawai Bay, 1 mile westward of Kukuiula Bay, indents the coast about ¼ mile and is about 300 yards wide. Its sides are low and rocky, but there is a wide sand beach at the head, back of which, in the gulch, is a privately owned park. A large, lone, grass-topped rock, about 70 feet (21.3 m) high, stands at the upper edge of the sand and on the west side of the stream. There is fair protection from the trade winds for small boats, but the bay is open to the southwest.

Makaokahai (Hinalua) Point, about 4½ miles westward of Makahuena Point, is easily recognized by several hills extending northward from it; especially one well-rounded 440-foot (134 m) hill, ½ mile inland, which is evenly capped with trees and whose lower slopes are cane fields. The first low hills on the point are the walls of a water-filled crater.

Lanipuao Rock, with 3 feet (0.9 m) over it, is about ¼ mile southeastward of Makaokahai Point, and is marked by a lighted buoy (flashing red). Vessels should not attempt to pass northward of the buoy.

Wahiawa Bay (chart 4108), 1 mile east of Port Allen, is 200 yards wide at its entrance and indents the coast about ¼ mile. It affords excellent protection in all but southerly winds. Small craft anchor in from 5 to 10 feet (1.5 to 3 m), sandy bottom. It is too small and shallow for large vessels. The sides of the bay are rocky, and seas usually break over the shoal 100 yards off **Weli Point,** on the southeast side of the bay.

Hanapepe Bay (Port Allen, chart 4108), near the middle of the south coast of the island, is about ½ mile wide and indents the coast about ⅜ mile. It affords shelter during the trades, with fair holding ground, but kona storms sometimes interfere with ship traffic during the winter months. The shores of the bay are low rocky bluffs, except at its head, where there is a sandy beach. The bay is 1¾ miles west of the conspicuous gray stack and buildings of the McBryde Mill, the bright lights of which are a good night mark. The landing is on the easterly side of the bay just inside the small breakwater, which is built out 100 yards from the easterly point at the entrance. There are no wharves for large vessels, which anchor or moor to the buoys in the bay and discharge and load cargo from lighters. The prevailing current is westerly.

Prominent features.—The easterly side of the bay is marked by three large and three small white oil tanks, several large warehouses, and a tall flagpole which is near the inshore end of the breakwater. A fixed red light, maintained by private interests, is shown from a small tripod close to the flagpole on the easterly side of the bay. **Puolo Point,** forming the westerly side of Hanapepe Bay, is low, flat, and rocky, and is marked by **Hanapepe Light** (occulting white with red sector covering Lanipuao Rock). Port Allen Landing Field lies between Hanapepe Light and two tall orange-and-black radio towers, ½ mile northeastward of the light.

Port Allen, formerly called Eleele Landing, is the shipping center of the southwestern side of the island, and large freighters, as well as the local steamers, make regular calls. The principal exports are sugar, molasses, and pineapples; coal, nitrate, and lumber are imported. Vessels calling for freight drop their starboard anchor off the easterly mooring buoys in about 10 fathoms (18.3 m), and while swinging to the trade wind, make fast to bow and stern mooring buoys. Numerous lighters and towing launches are available, and sugar has been loaded at the rate of 2,000 tons per day. There is a pilot boat, and on request pilots will board vessels about 1 mile east of the bay. Pilotage is advisable but not compulsory; there are no pilot fees, but a rental is charged for the use of the mooring buoys, which are privately maintained. There are no facilities for bunkers, repairs, or towing. There is a quarantine

officer, and a privately owned hospital. Provisions can be obtained on several days' notice. Fresh water may be had alongside ship.

A reef makes out about 200 yards from the shore just southeast of the Port Allen oil tanks, and another reef extends 150 yards off the point ¼ mile southeast of the breakwater. In heavy weather breakers extend for 350 yards offshore in the northwest side of the bay and from 50 to 150 yards off the southeasterly side of Puolo Point. A small shoal with a least depth of 30 feet (9.1 m) lies about 1,355, yards 93° true (E. ¾ N. mag.) from Hanapepe Light. This shoal is marked by a nun buoy with red reflectors.

Hanapepe River enters the northeasterly end of the bay through a deep gulch. Boats can enter at high water, taking care to avoid the rocks at the entrance.

Makaweli Mill, painted red and with a prominent red stack, is about halfway between Puolo Point and Makaweli Landing and about ⅜ mile inland. A row of street lights running normal to the general coast line is conspicuous at night. Between the mill and Makaweli Landing, shoal water extends offshore ⅛ to nearly ½ mile.

Makaweli Landing (chart 4114), about 4½ miles northwestward of Port Allen, is on the easterly side of Hoanuanu Bay. The wharf, which is marked by a derrick, has a depth of 8 feet (2.4 m) at its outer end. There is a large warehouse near the inshore end of the wharf. One-fourth mile south of the wharf is a large group of laborers' huts. The easterly side of the bay is rocky, while the portion of the bay north and west of the wharf has a sandy beach backed by trees. The landing is but little used as a shipping point, but there is good protection from the trades for small boats.

Makaweli Reef extends about ¾ mile off Poo Point, halfway between Makaweli Landing and Waimea. It is marked by a lighted buoy, and vessels should not attempt to pass inside the buoy.

Waimea Bay (chart 4114), on the southwest side of Kauai, is an open bight affording good anchorage during ordinary weather in from 3 to 20 fathoms (5.5 to 37 m) sandy bottom. It was here, in 1778, that Capt. James Cook, R.N., first landed in the islands. The village, at which provisions in limited quantities may be obtained, is situated in back of the sand beach in a coconut grove. There is a wharf having a depth of 11 feet (3.4 m) ot its outer end. Depths at the wharf are subject to changes due to the wave action on the sandy bottom. A shoal from ¼ to ⅜ mile wide and having depths of from 6 to 14 feet (1.8 to 4.3 m) fringes the shores of the bay. There are two mooring buoys southwestward of the wharf, in 2½ and 6 fathoms (4.6 and 11 m). Steamers no longer call here regularly. Small boats generally shift anchorage to Makaweli for better protection when the trades are strong.

Prominent features.—The mill stack northwestward of the wharf and 200 yards from the shore, and the church spire, 500 yards northward of the wharf, are conspicuous.

Approach on a 14° true (N. ¼ E. mag.) course, with the outer end of the wharf and the church spire on range ahead. Select anchorage just westward of this range and about ½ mile off the wharf. Strangers should use the lead, as the 3-fathom (5.5 m) curve is 600 yards offshore.

Waimea River empties into the bay on the easterly side of the town, and the bar at its mouth prohibits the entrance of all but pulling boats. The river comes down from the mountains through the deepest gorge on this part of the island.

From Makaweli westward the coast line is almost a continuous sand beach (usually visible at close range at night), with several scattered patches of rocks. Between Waimea and Oomono Point reefs make out for a distance of about ⅜ mile. The reef breaks in heavy weather. Between Oomono and Nohili Points the 10-fathom (18.3 m) curve lies about ½ mile offshore. A low, flat plain, about 2 miles wide, extends westward from Waimea around the western end of the island to a point about 4 miles southward of Alapii Point, The seaward edge of this plain has a growth of algaroba trees, behind which several sand dunes can be seen. Sugar is grown as far west and north as Nohili Point.

Kekaha, 2½ miles westward of Waimea, is a plantation settlement marked by two gray mill stacks close together, and about ¼ mile inland. The northwesternmost stack is 200 feet (61 m) tall and is built of concrete. These are the most westerly stacks on the island.

Kokole Point, 5 miles westward of Waimea, is low, rounding, and wooded. It is marked by a flashing white light. There is good anchorage for vessels, along the open coast from Kokole Point eastward for a distance of 1½ miles.

Mana Point, about 4 miles northward of Kokole Point, is the westernmost part of the island. Along the water's edge is a sand bank which extends for 2 miles both northward and southward from the point. From offshore, the coast appears to be a sandy beach, but the sea breaks on a lava-ledge bottom at the edge of the sand, making the beaching of boats dangerous except when the sea is smooth. The south drainage canal, at **Waieli,** 1 mile south of Mana Point, is prominently marked by a broken group of ironwood trees, much taller than other vegetation in the vicinity. Mana village, 1 mile inland from the point, is marked by several large bushy trees. Discolored water, caused by the undertow from the beach and canals, is often noted at a distance of 2 miles off Mana and Kokole Points. The lowlands in back of the point extend for 2 miles to the sheer bluffs of the mountains.

Nohili Point, about 2 miles northward of Mana Point, is marked by Nohili Dune, 100 feet (30 m) high, the highest and most southerly of a chain of sand dunes extending along the coast for 2½ miles to the northeastward. These dunes are known on the island as the **Barking Sands** and mark the northern limits of the roads and cane fields on this side of the island.

From Makaha Point southward to the dunes, a distance of 2½ miles, the coast is mountainous and rocky. There is a narrow sand shoal, having depths of 7 to 10 fathoms (12.8 to 18.3 m), extending from Nohili Point north-northeastward for 7 miles. The shoal, which appears to be a succession of sand ridges extending in an east-west direction, lies from 1 to 2 miles from the shore, with deeper water between. The northwest coast, between Alapii and Kailiu Points, a distance of 7½ miles, consists of a series of precipitous cliffs known as **Napali.** These cliffs are 2,000 feet (610 m) high in places, are much cut up, and have numerous streams forming small

waterfalls. The southerly half of this section of the coast is practically bare, while the northerly half is wooded. A depth of 4 fathoms (7.3 m) is found about ½ mile off **Alapii Point,** and the 15-fathom (27.4 m) curve between this point and Kailiu Point is about 1 mile offshore.

Kailiu Point, the extreme northwesterly point of Kauai, is the seaward end of a jagged ridge, which ends abruptly in a sharp peak about 1,000 feet (305 m) high. There is a narrow strip of lowland at the point.

Haena Point (chart 4118), 1⅛ miles eastward of Kailiu Point, is low and rounding. One-fourth mile inland, under the bold face of the mountains, are the **Haena Caves,** which cannot be seen from seaward. The caves mark the western terminus of the highway which skirts the northern side of the island. A tortuous trail leads to the old village of **Kalalau,** 5 miles southwestward of the point. A reef, which bares at low water, makes out 600 yards northwestward from the point, and the 15-fathom (27.4 m) curve is 1½ miles offshore.

Wainiha Bay (chart 4118), 1¼ miles eastward of Haena Point, is an open bight ¾ mile wide between **Kepuhi** and **Kolokolo Points.** The bay affords but little protection except in kona weather. An extensive reef lies along the western side of the bay, and in heavy weather the sea breaks ½ mile off Kepuhi Point, on the northwest side of the bay. The small wharf at the head of the bight was built to land equipment for power development on the Wainiha River. The river enters the bay from the most westerly of the deep valleys on the north side of the island. Enter on course 225° true (SW. by S. mag.), with the old wharf ahead; the chart is the guide for anchoring.

Lumahai River enters the sea at Kolokolo Point, at the western end of Lumahai Beach. The river is not navigable. The beach is of sand, with a few rocky patches. Lumahai valley is the western limit of the many rice fields on the north side of Kauai.

Makahoa Point is a black, rocky point forming the west side of Hanalei Bay. Back of the point is a high, green hill.

Hanalei Bay (chart 4118), on the northern side of Kauai, is about 1 mile wide between Makahoa and Puupoa Points and indents the coast about the same distance. A coral reef 300 to 700 yards wide, over which the sea generally breaks, fringes the shore on both sides. Along the sandy beach at the head of the bay are clumps of ironwood and coconut trees and a few houses. Enter midway between the two entrance points on a 157° true (SE. by S. mag.) course and anchor in 6 fathoms (11 m), sandy bottom, about ½ mile from shore. During northerly or northwesterly gales the sea breaks across the entrance to the bay, but there is good protection from the easterly trades. **Hanalei River** empties into the bay about ½ mile inside the easterly entrance point, and is navigable for boats of shallow draft for a distance of 2 or 3 miles. At high water, 4½ feet (1.4 m) can be carried over the bar at the mouth of the river. A prominent clump of ironwood trees marks the northern side of the river mouth. The wharf is situated 200 yards south of the river mouth and has 6 feet (1.8 m) of water on the southerly side of its outer end. No vessels call here regularly.

Waioli River and Waipa River empty into the westerly part of Hanalei Bay. They are not navigable. Rice is grown extensively on these rivers and all along the Hanalei River. **Hanalei Village** consists of a scattering of houses around the shores of the bay and along the highway close to the head of the bay. Three miles inland the mountains attain a height of over 4,000 feet (1,219 m).

Puupoa Point, on the easterly side of the entrance to Hanalei Bay, is a bluff about 50 feet (15.2 m) high, back of which a green ridge makes inland. From offshore the northerly side of Kauai presents a very irregular and jagged skyline, with ridges running in every direction. In the northwesterly part of the island these ridges often end abruptly at the sea. The mountains are heavily wooded. The coast between Hanalei and Kalihiwai Bays is a series of more or less wooded bluffs, much cut up by gulches, back of which a rolling plain extends to the mountains. Between the shore and the highway, 1 mile inland, are pineapple and sugarcane fields.

Kalihiwai Bay (chart 4118), 4½ miles eastward of Hanalei Bay, is marked on the easterly side by **Pukamoe Point,** a red precipitous bluff about 150 feet (46 m) high. The bay is about ½ mile in diameter, and there are several houses scattered along the sand beach at its head. The gulch at the head of the bay is wooded. An indifferent anchorage, with poor holding ground, can be found in 5 fathoms (9.1 m) in the center of the bay, but during northerly winds a heavy swell sets in. A reef ¼ mile wide, which bares at low water, extends for 2½ miles westward from Kalihiwai Bay, and vessels should keep ¾ mile offshore. A shore road, with beach houses along it, leads westward from the bay for 1½ miles. There is a rock awash 150 yards off Pukamoe Point.

Kilauea Point, about 6 miles eastward of Hanalei Bay, is a grass-covered bluff 165 feet (50 m) high. It is marked by Kilauea Point Lighthouse, a white conical tower about 60 feet (18.3 m) high, from which is exhibited a group flashing white light. Near the lighthouse and on the bluff is a small building and two 80-foot (24.4 m) radiobeacon towers, which send out groups of 2 dashes during thick weather and also operates the second 15 minutes of each hour (Hawaiian time; 157°30′ west longitude) during clear weather. **Mokuaeae Island,** 200 yards off the point, is a black, flat, grass-topped rock about 200 yards in diameter and 92 feet (28 m) high. It is the most northerly point of Kauai and the most prominent feature of the vicinity when coasting.

Kilauea Mill and village, about 1¼ miles inland from Kilauea Point, is not easily seen when close inshore. The mill stack is of black iron. The sugar of the district goes by rail to Ahukini for shipment. Between Kilauea Point and Mokolea Point, which lies about 1¼ miles southeastward, the coast is bluff, rising gradually from each point to an elevation of about 500 feet (152 m) about midway between them.

Makapili Rock, ¾ mile southeast of Kilauea Point, is 156 feet (48 m) high, black, and prominent. It juts out 200 yards from the shore, with which it is connected by a narrow neck of land.

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Mokolea Point is narrow, 140 feet (43 m) high, and projects out 3/8 mile from the general coast line. It forms the westerly side of Kilauea Bay and is marked near its seaward end by two old landing buildings.

Kilauea Bay (chart 4118), 1½ miles southeastward of Kilauea Point, is about ½ mile wide and indents the coast about the same distance. It is open to the trade winds but offers protection in westerly weather. Anchorage can be had in 6 fathoms (11 m), rocky bottom, near the center of the bay. A narrow coral reef fringes the shore, and Kilauea River empties into the westerly part of the bay. The mooring buoys and derrick, formerly used to load sugar, have been removed, and the bay is no longer used commercially.

Kapuhi Point is a low point 1⅞ miles eastward of Mokolea Point. The coast between the two points is low and fringed with a narrow coral reef.

Moloaa Bay, about 1½ miles southeastward of Kepuhi Point, is a small, open bay about ¼ mile in diameter in the mouth of a gulch. It is not surveyed, and without local knowledge should not be attempted. There are a few houses on the sand beach at the head of the bay. Rice is grown in the gulch. The interior between Moloaa Bay and Anahola Bay is used principally for the growing of pineapples and for grazing purposes.

Papaa Bay, about 1½ miles southeastward of Moloaa, is a bight open to the trade winds. It is not surveyed, and without local knowledge should not be attempted.

Anahola Bay, 1⅝ miles southeastward of Moloaa Bay, is marked on its southerly side by Kahala Point Light (flashing white). It is a small bight exposed to the trades, and on account of numerous reefs should not be attempted by strangers. Discolored water frequently extends for a considerable distance off Kuaehu Point, the northerly point of Anahola Bay. The reef off Kuaehu Point extends about ⅓ mile from shore. **Kahala Point** is a low bluff and has a grove of ironwood trees near the light.

Pinnacle Peak (Needle Point Mountain), about 1¼ miles westward of Anahola Bay, is the most prominent mountain peak in this part of the island. It is a tall, dark mountain spire with green slopes, just inland of a domelike mountain mass which marks the seaward end of a range of conspicuous peaks extending well into the interior of the island. Approaching from northward a natural arch can be seen, which looks like a small white house high up under the ridge. Between Kahala Point and Kealia the coast consists of low bluffs and a rocky shore with some patches of sand.

Kealia, about 3 miles southward of Kahala, is a plantation village marked by a black mill building with black stack. A short breakwater, extending southeastward from the north shore, affords some protection from northerly weather for boats of shallow draft. The breakwater is not kept in repair, and its outer end has been carried away by the sea. Vessels should not call here without local knowledge. About ¾ mile southwestward of the mill, on a low hill, is a flat, red building which is prominent from offshore.

Kapaa, 1½ miles southward of Kealia, is a comparatively large village scattered along the beach. It is marked on its northerly side by a tall, gray mill stack and on its southerly side by the large

buildings of a pineapple cannery. The cannery has four iron stacks, which are close together and in line. A sewer outfall, extending a short distance out from the low, sandy shore, is just seaward of the cannery. A reef, which makes out ⅓ mile in places, extends along the coast from the northern side of Kapaa to Alakukui Point, 2 miles southward. There is an opening in the reef at Kapaa; it is usually marked by breakers on either side. Vessels do not call here, but sampans find an anchorage in about 2 fathoms (3.7 m), behind the reef, and about 150 yards off the remains of an old wharf on the northern side of the village.

Wailua is a small village in **Lehuawehe Bay,** 2½ miles southwestward of Kapaa village. It consists of a few houses located on both sides of the mouth of the Wailua River. The river, which is spanned by a bridge at its mouth, is navigable for small boats for several miles, once the shifting bar is passed. A vessel could find an unprotected anchorage in from 10 to 15 fathoms (18.3 to 27.4 m), rocky bottom, but, like the whole northeast coast of the island, anchorage is not safe when the trades are blowing. **Waipouli Village,** on the highway, is 1 mile northeastward of Wailua.

Nonou Mountain, 1⅜ miles northwestward of Wailua, is 1,238 feet (377 m) high and is the northernmost and highest of the low mountains near the coast.

Kalepa Ridge is 1 mile inland and parallels the coast from Wailua to Hanamaulu. The southern end, which is 710 feet (216 m) high, is marked by three white radiotelephone buildings high up on the seaward face of the ridge. The buildings can be seen from many miles offshore and make a good leading mark to Hanamaulu Bay.

Hanamaulu Bay (Ahukini; chart 4112), 3 miles southward of Wailua and 3 miles northward of Nawiliwili, is ¼ mile wide and indents the coast ½ mile. There are several oil tanks, a large warehouse, and a wharf at Ahukini Landing, on the south side of the entrance. The wharf is not seen from seaward and the warehouse and tanks are partly hidden by the many trees on the point. The shores are low, rocky bluffs about 40 feet (12.2 m) high, except for the white sand beach at the head of the bay. A fringe of ironwood trees on the bluffs form a windbreak for the extensive cane fields on either side of the bay. Only the outer third of the bay has deep water; the sand and coral bottom shoals gradually from the 18-foot (5.5 m) curve to the beach at the head of the bay. The most prominent mark from offshore is the previously mentioned group of three white buildings on the southern part of Kalepa Ridge, 1½ miles west-northwestward of the bay. Just southward of Kalepa Ridge and 1 mile inland is a mill settlement, the lights of which are prominent at night.

Ahukini Breakwater Light marks the outer end of a 300-foot (91 m) breakwater, which extends northwesterly from the southern point of the entrance. In the lee of the breakwater is a wharf 210 feet (64 m) long and having depths from 38 feet (11.6 m) at its southwesterly end to 25 feet (7.6 m) at the northeasterly end. The deep water leading to the wharf is marked on either side by channel buoys. Vessels coming alongside drop their port anchor after rounding the breakwater, run out lines to bow and stern mooring buoys, and make fast to the wharf starboard side to. There is a heavy surge at the wharf during rough weather.

There is a harbor master, pilot, and a quarantine officer. Pilotage is advisable but not compulsory. There are hotels, a hospital, and good general stores in Lihue, 2 miles inland. Fresh water is available at the dock, also gasoline and fuel oil. A 200-horsepower towboat is stationed at Ahukini. There are no dry docks.

Hanamaulu River empties into the bay of the same name. It is not navigable.

The coast between Wailua and Nawiliwili Bay consists of a series of low bluffs, with here and there stretches of sand beaches. There are no off-lying dangers. Sugarcane is extensively cultivated.

Kaulakahi, or **Niihau Channel,** lies between Kauai and Niihau, and is about 14½ miles wide and clear of obstructions. The trade winds follow the south coast of Kauai, and off Mana Point meet the air current that has followed around the northerly side. The trade winds blow directly across the lowlands of Niihau, but part of it is deflected southward and around the southeast point of Niihau.

Currents.—It is almost impossible to lay down any rules for the current, which somtimes sets southward along the east coast of Niihau at the same time that it is setting northwestward along the southwesterly coast of Kauai. During kona weather these conditions are changed.

NIIHAU (CHART 4117)

the seventh in size of the islands, is at the westerly end of the group. It is about 16 miles long in a northeast-southwest direction and varies in width from 3 to 5 miles. Near the middle of the island there is a high tableland with low projecting cones, or peaks, of which **Paniau Peak,** 1,281 feet (390 m) high, is the highest. The northerly and easterly ends of the tableland are precipitous, varying in height from 600 to 1,000 feet (183 to 305 m), while the southerly and westerly slopes are gradual. There are no streams on the island. A single ranch, devoted to stock raising, furnishes the sole occupation of the inhabitants. By the census of 1930, Niihau had a population of 136.

Communication.—There is no regular communication with Niihau, but local steamers call infrequently for cattle and wool. There is no telegraph or radio communication. A dirt road extends from the southern end of the island along the western shore to Kii.

Lehua Island, about ½ mile northward of Niihau, is a small, rocky, crescent-shaped island, open northward. The easterly and westerly points are low, rising gradually to an elevation of about 702 feet (214 m) near the center of the island. On the westerly point of the island there is a natural arch. **Lehua Channel,** between Niihau and Lehau, is restricted on its southerly side by rocks showing above water, which extend about half-way across it. This channel affords a depth of 7 fathoms (12.8 m) and in passing through it, the Lehua Island side should be favored, keeping about 350 yards from the Lehua shore. In heavy northwest weather the swells all but break in the passage, and as but little is to be gained by the channel, vessels should pass outside of Lehua.

To the eastward of this passage steamers should give the north coast of Niihau a berth of ½ mile, while to the west the clearance should be about 1 mile. The current through this passage varies

with the tide and runs in both directions, with a maximum velocity of about 1½ knots. **Lehua Rock Light** (flashing white) marks the highest point of Lehua Island.

Puukole Point, the north point of Niihau Island, is low, as is **Kikepa Point,** 1 mile eastward. Between these points and the high bluffs marking the northerly side of the tableland, the land is low and grass-covered with a few low hills. From a distance this lowland is not seen, and Lehua Island appears to stand off 3½ miles from Niihau.

Kaunuopou Point, 2½ miles southeastward of the north end of the island, is the easternmost point of Niihau. **Kaunuopou Rocks,** over which the seas break, lie 300 yards off the point. Another rock, located about ⅜ mile off the south side of the point, usually breaks and should be given a good berth when approaching Kii.

Kii Landing, a small bight about ⅝ mile west of Kaunuopou Point, is only slightly protected from the trade winds. It affords a landing during ordinary weather but cannot be used during southerly weather. The landing is built on beach bowlders and has only 2 or 3 feet (0.6 or 0.9 m) of water. Anchorage may be had in about 8 fathoms (14.6 m) coral bottom, about ⅝ mile off the landing. About 1¼ miles southward of Kii Landing a reef with 2 fathoms (3.7 m) over it extends ½ mile offshore and is usually breaking. The 10-fathom (18.3 m) curve is about 1 mile offshore here. From the vicinity of the reef to Pueo Point the coastline consists of cliffs reaching a height of 1,000 feet (305 m).

Pueo Point, 5 miles southward of Kii Landing, is a prominent, brown, precipitous bluff about 800 feet (244 m) high. Southwestward from Pueo Point the coastline consists of bluffs broken by small bights, most of which have short, sand, or pebble beaches where boats could land during smooth weather. These bluffs continue for a distance of 4½ miles, gradually diminishing in height to the lowlands of the southern half of the island.

The lowland of the southern part of the island is broken by two hills—Cape Kawaihoa at the south end and Kawaewae, which is a gently rounded hill 315 feet (96 m) high, 4 miles north of Cape Kawaihoa and 1¼ miles from the west coast. The coast between Pueo Point and Cape Kawaihoa has no known dangers, the few isolated rocks being very close to shore. From Cape Kawaihoa northward for 6 miles the east coast consists of a series of low bluffs about 15 feet (4.6 m) high, with stretches of sand beaches, a few sand dunes, and scattered trees.

Cape Kawaihoa, the southernmost point of Niihau, is formed by a hill 548 feet (167 m) high, the seaward face of which is steep. From a distance the hill appears as an island and can easily be mistaken for Kaula. There is deep water close to the cape. About 2 miles south of the cape there is a prevailing westerly current which reaches a velocity of about 1½ knots. From Cape Kawaihoa the coast gradually curves westward and northward and is low and rocky with short sand beaches in places. At **Leahi Point,** 1¾ miles westward of the cape, the 10-fathom (18.3 m) curve is ⅝ mile offshore.

Kamalino, 4 miles northwestward of the cape, is an abandoned village with a few houses still standing. The coast between Kamalino and Puukole Point is practically one low, continuous beach, with an occasional group of rocks. Near the beach are numerous

sand dunes covered with sparse vegetation. A dirt road skirts the western side of the island

Nonopapa Landing, 5½ miles northwestward of Cape Kawaihoa, is marked by a large dark shed and derrick on a short concrete retaining wall, at the north end of a long sand beach. Local steamers call here occasionally for the island produce of stock, wool, and honey. Anchorage may be had in 8 fathoms (14.6 m), coral and sand bottom, with the center of the shed and Kaeo Cone in range and bearing 70° true (NE. by E. ¼ E. mag.), the derrick 660 yards distant. Kawaewae hill, previously mentioned, is about 1½ miles distant and bears 135° true (SE. by E. mag.) from this anchorage. **Kaeo Cone** is a low cone near the center of the tableland, and from the anchorage shows on the skyline. The landing itself is somewhat protected by a small reef extending southwest from the end of the retaining wall, for a distance of about 75 yards. Small boats approaching the landing head south of it until the reef is rounded. The landing is used only from May to September, as during the winter months there is often a heavy northerly swell. The natives of the island live in a small village about 2 miles northeast of the landing.

Kuakumoku Rock, 1½ miles north of Nonopapa Landing, is a large single rock about 4 feet (1.2 m) above water and located near the center of a reef some 200 yards in diameter. This is about 550 yards offshore and should be given a berth of ½ mile. Only small boats should attempt the passage inside of this reef. About ½ mile southward of the rock a reef extends ¼ mile offshore, and 3 miles northeastward of the rock a reef extends ½ mile offshore.

Kaununui Point, 5¾ miles northeastward of Nonopapa, is marked by a group of rocks a few feet high and close to the shore. A coral reef with 6 fathoms (11 m) over it lies 1½ miles off the point and 6 miles 231° true (SW. ½ S. mag.) of Lehua Island. It is reported that the reef breaks in heavy weather. The bottom from this reef shoreward is coral and is fairly uniform for a distance of 1 mile when it shoals gradually to the beach. The passage inside of this reef is not recommended except for small boats.

Keawanui Bay is no more than a slight curve in the shore line from Kaununui Point for 3 miles northeastward. The bay has a sand and coral bottom and a sandy shore. A rock with only 2 feet (0.6 m) over it lies in the southwestern part of the bay ½ mile offshore and ¾ mile northeastward of Kaununui Point.

From the northern side of the bay to Puukole Point (the north end of the island) the coast is foul for a distance of ⅝ mile from shore. Vessels should keep 1 mile offshore. About 1¾ miles southwestward of Puukole Point and ⅝ mile offshore is a reef with 16 feet (4.9 m) of water over it; ⅞ mile south by west of this reef and ⅝ miles offshore is a rock with 5 feet (1.5 m) of water over it.

Kaula, about 19 miles southwestward of Niihau, is a small, bare, rocky islet 550 feet (168 m) high. It is marked by a flashing white light on a white skeleton tower on the highest part of the islet. A rock with a least depth of 5 fathoms (9.1 m) lies 3¾ miles 300° true (WNW. ¼ W. mag.) from the highest point of Kaula. A bank with depths from 30 to 40 fathoms (55 to 73 m) extends for 5 miles northwestward from the islet. Vessels have anchored close to both the south and east sides of Kaula in about 20 fathoms (37 m), but as the islet is only about ¾ mile long, there is but little protection.

REEFS AND ISLANDS WESTWARD OF KAUAI

NIHOA OR MODU MANU (BIRD ISLAND) (CHART 4000)

is a barren, rocky island about 133 miles 297° true (WNW. ⅝ W. mag.) of the westerly end of Kauai, in latitude 23°03′29″ N., longitude 161°55′25″ W. The island is about ¾ mile long and averages a little more than ¼ mile in width. The easterly, northerly, and westerly sides of the island are high and precipitous, while the southerly side is much lower and its slopes are more gradual. The greatest elevation is **Millers Peak**, near the northwesterly end of the island, which is 910 feet (277 m) high. **Tanager Peak**, near the northeasterly end, is 874 feet (266 m) high.

The southeast and southwest sides of the island terminate at points forming a bay known as **Adams Bay**. There are three small bights in this bay, the westerly one having a sand beach, while the shores of the other two are rock ledges. The middle cove is probably the best landing place; however, the rise and fall of the swell is considerable and great care must be taken in landing anywhere on the island. A steep trail from the middle cove leads to the top of the bluff. At the foot of the bluff there is a seepage of water which is not suitable for drinking purposes except in emergencies. There is deep water close to all sides of the island.

The island is uninhabited, and, except for the seepage mentioned in the preceding paragraph, no water can be obtained. The island is of historic interest, and the low stone walls of ancient ceremonial sites still remain. Many stone images and other evidence of past visitations have been removed to the Bishop Museum in Honolulu. The island is the resort of many sea birds of several species.

Nihoa is near the southwesterly end of a bank which is about 20 miles long and 14 miles wide, with depths of 20 to 30 fathoms (37 to 55 m). Another bank, the center of which is about 18 miles west by south from Nihoa, is about 17 miles long and 12 miles wide and has depths of 16 to 24 fathoms (29 to 44 m). Other banks eastward and westward of Nihoa have least depths of 32 fathoms (59 m). The edges of these banks break down steeply to great depths. They are all shown on chart 4000.

Anchorage.—The safest anchorages are between the 15- and 20-fathom (27.4 and 37 m) curves westward and southwestward of the island. There is some tendency to drag anchor here.

Currents.—The prevailing current is westerly south of the island and northwesterly to northerly west of the island. Westerly currents of about 1½ knots have been observed during normal trade-wind weather.

NECKER ISLAND (CHART 4000)

is a rocky island lying about 158 miles 282° true (W. ⅛ N. mag.) of Nihoa, in latitude 23°34′41″ N.; longitude 164°42′22″ W. The island is approximately ¾ mile long in an east and west direction and is less than ⅛ mile wide. It is made up entirely of lava rock, and has four peaks or hills, one near each end and two between; the highest, **Summit Hill**, is near the middle of the island and is 277 feet (84 m) high. **Annexation Hill**, 249 feet (76 m) high, at the southwestern end of the island, is separated from the other hills by

a low saddle, making it from a distance appear detached. The sides of the island are precipitous, with 5 to 8 fathoms (9.1 to 14.6 m) alongside.

A rocky spur extends northward from the west end, forming **West Cove** and **East Cove** (Shark Bay). These two coves are the best landing places, but there are times when it is impossible to land anywhere on the island. **Shark Bay** is open to the northeast trades and is usually filled with breakers. A small, detached, low rock extends about 100 yards off the eastern point of the island.

The island, which might well be called a rock, is uninhabited, but, like Nihoa, shows unmistakable evidence of ancient habitation. There is a sparse growth of low brush on the upper slopes of the hills. At certain seasons of the year some water may be found in a small ravine which makes down from the southeastern side of the island. Other small seepages of unpalatable water have been reported. The island is the home of countless sea birds.

Necker Island is near the northern end of a bank about 42 miles long in a northwesterly direction. The bank is about 15 miles wide, and has depths of from 9 to 25 fathoms (16.5 to 46 m). The sand and coral bottom is plainly visible.

Anchorage.—Vessels can anchor in about 12 fathoms (21.9 m) ½ mile south of the southwestern point of the island. The island is so small that it offers but little protection.

Tide.—The rise and fall of the tide is about 2 feet (0.6 m).

Current.—The prevailing current is westerly, but close to the island countercurrents may be expected.

Winds.—September is said to be the calmest month of the year; strong north and northeast winds prevail during the other months.

FRENCH FRIGATE SHOAL (CHART 4000)

lying 85 miles 278° true (W. ¼ S. mag.) of Necker Island, is a crescent-shaped atoll with a number of small, bare, sand islets on it. It is about 17 miles long in a north-northwesterly direction, and about 12 miles wide at the southern side. In addition to the sand islets, the shoal has numerous coral heads and reefs, over which the seas generally break, with areas of deeper water between. **La Perouse Pinnacle** is a volcanic rock islet about 60 yards long and 20 yards wide, and is 122 (37 m) feet high. It lies midway between the points of the crescent, on the west side of the shoal, in latitude 23°46′01″N.; longitude 166°15′47″ W. The islet is so steep and rugged that it is almost inaccessible. A small detached rock about 9 feet (2.7 m) high lies just off the westerly end of the islet. La Perouse Pinnacle is visible for 8 or more miles, and from a distance resembles a brig under sail. The points of the crescent, as indicated by the ends of the line of breakers, bear 166° true (SSE. ¼ E. mag.) and 310° true (NW. by W. ⅜ W. mag.) from La Perouse Pinnacle.

East Island, 3 miles 69° true (NE. by E. ⅛ E. mag.) from La Perouse Pinnacle, is a low sand islet 600 yards long in a northwesterly direction and 100 yards wide. It is about 10 feet (3 m) high, has a scattering of low weeds, and, like all the islets of this group, is the nesting place of sea birds and turtles. A reef, awash most of the time, extends 1¼ miles westward from East Island, and another ex-

tends ¼ mile to the southward from the southeast end of the same island; the latter reef is seldom marked by breakers at its off shore end. A coral head, not always marked by breakers, lies ⅝ mile south of the southeast end of East Island. **Bare Island,** a very small sand islet, lies ½ mile northeastward of East Island. **Shark Island,** the most northwesterly of the several sand islets, lies 6 miles 325° true (NW. ⅛ W. mag.) from La Perouse Pinnacle. Water, somewhat brackish, has been found by digging wells about 8 feet (2.4 m) deep on the sand islets back from the beach.

The bank, with depths of 10 to 20 fathoms (18.3 to 37 m), extends for 6 miles westward of La Perouse Pinnacle, where the bottom drops off rapidly to great depths. The water northeast and south of the reef, however, is very deep.

Anchorage.—The best holding ground southwest of the reef is found in depths from 13 to 15 fathoms (23.8 to 27.4 m), the bottom in less depth being mostly coral. The best anchorage is found ¾ mile southwestward of East Island in 14 fathoms (25.6 m), with the southeast end of that island and Bare Island in range. From this anchorage, the center of East Island bears 28° true (N. by E. ½ E. mag.), distant ¾ mile; the coral-head breaker ⅝ mile south of East Island bears 90° true (E. by N. mag.) distant ½ mile; La Perouse Pinnacle bears 261° true (WSW. ¼ W. mag.), distant 2⅝ miles. This anchorage has good holding ground and is protected from northeast and easterly winds but is exposed to the westward. Another anchorage with less protection lies 1 mile northwestward of La Perouse Pinnacle, in about 14 fathoms (25.6 m). There is an 8-fathom (14.6 m) spot ½ mile northwestward of this anchorage.

There is no anchorage for large vessels protected from all weather. Small vessels, by picking their way through the coral heads, can get very good protection behind the shoals from any kind of weather.

Directions.—Vessels may approach the shoals, *in the daytime,* from the north, east, and southeast without fear. On clear days La Perouse Pinnacle is plainly visible from every direction outside the shoals. From the south, the approach is not so safe. There is shoal water over the reef which may not break, and although the bottom is plainly visible when fairly close, the shoal water might not be detected some little distance away.

Vessels can approach La Perouse Pinnacle safely on any course between 15° true (N. ⅜ E. mag.) and 125° true (SE. by E. ⅞ E. mag.). Approaching from westward, anchor anywhere on the 10- to 20-fathom (18.3 to 37 m) bank which extends 6 miles westward of the pinnacle, or pass ½ mile southward of the pinnacle on a 70° true (NE. by E. ¼ E. mag.) course, crossing depths of 8 fathoms (14.6 m), and anchor southwestward of East Island as previously described.

Approaching from the southward keep La Perouse Pinnacle ahead on a course of about 15° true (N. ⅜ E. mag.) and anchor ¾ mile southward of the pinnacle; or proceed from here to the anchorage southwestward of East Island.

Approaching from northward, give Shark Island (the northwestern islet of the group) a berth of about 2 miles, then head for La Perouse Pinnacle, bearing about 125° true (SE. by E. ⅞ E. mag.), and anchor northwest of the pinnacle as described above.

Currents.—The prevailing current in the vicinity of French Frigate Shoal is westerly.

Winds.—The northeast trades prevail throughout the year, but westerly blows can be expected during the winter months.

BROOKS SHOAL (CHART 4000)

and **Saint Rogatien Bank** form a group of five coral banks, totaling 50 miles in length, situated between French Frigate Shoal and Gardner Pinnacle. They are strung out in a northwesterly direction, have depths of from 11 to 40 fathoms (20.1 to 73 m), and are separated by channels over 100 fathoms (183 m) deep and several miles wide. The largest and shoalest of these banks lies 60 miles 305° true (NW. by W. 7/8 W. mag.) from La Perouse Pinnacle (French Frigate Shoal). This bank has depths of 11 to 20 fathoms (20.1 to 37 m) and is about 12 miles in diameter.

The southeasterly bank lies 27 miles 301° true (WNW. 1/4 W. mag.) from La Perouse Pinnacle. This bank, the smallest in the group, is about 2 miles in diameter and has depths of 28 to 40 fathoms (51 to 73 m).

The northwesterly bank lies 75 miles 311° true (NW. by W. 3/8 W. mag.) from La Perouse Pinnacle and is about 6 miles long and 3 miles wide. It has depths of 30 to 40 fathoms (55 to 73 m).

Anchorage.—Unprotected anchorage can be had on the shoaler areas, with plainly visible sand and coral bottom. The holding ground is only fair. There are no dangers.

Currents.—The prevailing current is westerly, but it is influenced somewhat by the tides.

GARDNER PINNACLE (CHART 4000)

is a solid, volcanic rock islet lying 120 miles 308°30′ true (NW. by W. 5/8 W. mag.) of La Perouse Pinnacle (French Frigate Shoal) in latitude 25°00′04″ N., longitude 167°59′52″ W. It is 190 feet (58 m) high, about 200 yards in diameter, and has a smaller pinnacle rock close to its northwesterly side. It is barren of vegetation and covered with guanò, giving it the appearance of being snowcapped. There are no off-lying dangers. In comparatively smooth weather, landings can be made just north of the bight on the west side of the pinnacle.

Gardner Pinnacle lies near the northeastern side of a bank 52 miles long, in a north and south direction, and 22 miles wide near its northern end. This bank has depths of 9 to 22 fathoms (16.5 to 40 m), and the sand and coral bottom is plainly visible.

Anchorage can be had anywhere on the bank, but there is no protection. In general, the holding ground is poor.

RAITA BANK (CHART 4000)

lies 85 miles 291° true (W. 7/8 N. mag.) from Gardner Pinnacle in latitude 25°32′ N., longitude 169°28′ W. It is 20 miles long in a north-northeasterly direction and has a maximum width of 9 miles. It has depths of from 9 to 20 fathoms (16.5 to 37 m), and the bottom of sand and coral is plainly visible under ordinary weather conditions. At the 20-fathom (37 m) curve the bottom

drops off rapidly to great depths. In heavy weather the swells seem to lump up slightly over the shoaler areas, but there are no dangers. Large schools of Ulua fish and sharks have been observed on the bank.

Anchorage can be had anywhere on the bank, in the open sea, with fair holding ground.

MARO AND DOWSETT REEF (CHART 4000)

60 miles westward of Raita Bank, has its center in latitude 25°25′ N., longitude 170°35′ W. It is composed of a large, oval-shaped coral bank 31 miles long in a northwesterly direction and 18 miles wide, in the center of which is a large area of reefs awash. The broken reef area is 12 miles long in a northwesterly direction, and 5 miles wide. Outside of the reef, which is practically always marked by breakers, the wide shelf of the bank has depths of from 12 to 20 fathoms (21.9 to 37 m). The area of the broken reef is extremely foul, with many coral heads awash and channels of deep water between. There is only one very small rock which shows above high water. It is only about 2 feet (0.6 m) high and is on the north side of the reef.

Dangers.—There is nothing visible by which the navigator can definitely locate himself. Breakers, or the light blue-green color of the area within the reef, give the first warning of the proximity of the reef. All maneuvering in the vicinity of the reef must be done with extreme caution, and with the sea and light such that shoal spots can be seen and avoided. Ordinarily, spots with less than 6 fathoms of water are plainly visible.

There are no dangers over 1½ miles from the general outline of the reef, thus leaving a navigable shelf with 12 to 20 fathoms (21.9 to 37 m) of water, on all sides of the reef. This navigable area of the bank varies in width from 3 miles on the southeast side to 11 miles on the west and northwest sides.

Anchorage.—Vessels may anchor in the shelter of the reef on any side; the closer to the reef the more caution is necessary to avoid the isolated coral heads. These coral heads can usually be seen in favorable sunlight. Good shelter from the northeast trades can be obtained on the west side between two long arms of the reef which project, one to the northwest and the other to the southwest, from the main reef area. Care must be taken to avoid the 5-fathom (9.1 m) spot off the middle of the entrance. Vessels in entering should keep within ½ mile of the southwest arm of the reef. However, unless the navigator is familiar with the area, he should remain as far from the broken-reef area on all sides as he can obtain the desired shelter.

Currents.—The prevailing current in the vicinity is westerly, but on the bank the current tends to rotate clockwise around the broken-reef area.

LAYSAN ISLAND (CHART 4000)

is a low sand island lying about 65 miles 288° true (W. ⅝ N. mag.) from the center of Maro and Dowsett Reef, in latitude 25°46′ N., longitude 171°44′ W. The island is 1⅞ miles long in a north and

south direction, about 1 mile wide, and has an elevation of 35 feet (10.7 m) near its north end. It is fringed with a narrow coral reef and is partly covered with low vines and grass, but the general appearance is white sand. The center of the island is a salt-water lagoon about ¾ mile long. Water may be obtained by digging shallow wells, and sea fowl, eggs, and fish are abundant. The island is marked by two coconut trees and an ironwood tree, which are close to the ruins of a small building on the west side of the island. It is uninhabited and seldom visited, although in former times guano was collected and shipped to Honolulu.

The island lies just southeastward of the center of a circular bank about 14 miles in diameter, having depths of 15 to 20 fathoms (27.4 to 37 m), beyond which the water deepens rapidly.

Dangers.—There are no particular dangers to navigation. Coral heads covered with 5 to 7 fathoms (9.1 to 12.8 m) of water are numerous over the area out to 1½ miles from the island. The bottom of sand and coral can usually be seen in depths under 10 fathoms (18.3 m), and often in greater depths. When approaching closer than 1½ miles a sharp lookout must be maintained to detect the coral heads.

Anchorage.—Vessels can anchor from 1 to 1½ miles off the island in from 8 to 15 fathoms (14.6 to 27.4 m), on all sides, depending upon which side affords the best protection. Anchorage can be had from ½ to 1 mile off the west side of the island in from 8 to 15 fathoms (14.6 to 27.4 m), with fair holding ground. Small craft drawing not over 12 feet (3.7 m) can lie at anchor inside the reef and off the coconut trees on the west side of the island, except during westerly weather. This is also the best landing place during northeasterly to southeasterly weather, but landings are not safe during westerly winds. A poor landing can be made near the northeasterly end of the island during light westerly winds. The summer months are the best for landing, as then the northeast trades prevail.

Currents.—A current of 1 knot has been observed in the vicinity of the island. The current tends to be rotary in a clockwise direction around the island.

LISIANSKI ISLAND (CHART 4000)

is a small, low sandy island lying about 120 miles 278° true (W. ¼ S. mag.) from Laysan Island, in latitude 26°04′N., longitude 173°58′ W. It is about 1⅛ miles long in a north-northeast direction, ½ mile wide, and has an elevation of 20 feet (6.1 m) near the northeast side. The shores are of white sand except for two stretches of rock ledge at the water line on the east side of the island. The island is overgrown with vines and bushes, and there are no prominent features. The island is uninhabited and is seldom visited. Brackish water may be obtained by digging a few feet, and sea fowl, eggs, fish, and turtle are abundant. The island should be visited only during the summer months, when the northeast trades prevail.

Neva Shoal, with innumerable coral ledges, extends 8 miles southeastward from the island; this same reef, which is about 4 miles wide, has its western extremity about 4 miles south-southwestward of the island. The southeasterly end of the reef is usually marked

by breakers, and many of the ledges show breakers in most all weather. The reef has areas of deeper water between the ledges, and small boats can maneuver over many parts of the reef; however, it must be avoided by vessels.

A reef which circles around to the southwestward from off the north side of the island is marked near its offshore end by a coral ledge which bares at times and over which the seas break. This ledge is 1⅝ miles 260° true (WSW. ⅛ W. mag.) from the north end of the island. About ⅝ mile southwestward of this ledge is another ledge which is marked by a large breaker in most weather. Midway between these ledges or breakers is a passage leading to the lagoon between the island and the reef. The passage has an uneven bottom with depths from 2 to 6 fathoms (3.7 to 11 m). About 350 yards southwestward of the northern entrance ledge is a small shoal with only 3 feet (0.9 m) over it. These shoal spots are easily seen and avoided by small boats making the passage to the lagoon, but vessels should not enter without local knowledge. Once inside the lagoon, anchorage can be had in from 3 to 6 fathoms (5.5 to 11 m), taking care to avoid the scattered coral heads with only a few feet of water over them. Landings can be made on the west side and the south end of the island in all but southwesterly and westerly weather.

Lisianski Island lies in the center of a bank 24 miles long in a northwesterly direction and about 15 miles wide. Outside of the reefs, the general depths on the bank are from 12 to 20 fathoms (22 to 37 m).

Dangers.—Besides the dangerous reef extending 8 miles southeastward and 4 miles south-southwestward from the island, there are many coral heads, with from 3 to 6 fathoms (5.5 to 11 m) of water over them, which extend out for 3 miles on all sides of the island. A small coral ledge with about 3 feet (0.9 m) of water over it and nearly always marked by breakers lies 2¾ miles 254° true (SW. by W. ⅝ W. mag.) from the south end of the island. Between this ledge and the island there are depths up to 10 fathoms (18.3 m), with a scattering of coral heads, some of which are nearly awash. A 2-fathom (3.7 m) rock lies 1¼ miles north-northeastward of the north end of the island. This rock is marked by breakers only during heavy weather. Under favorable conditions dangerous coral heads can be seen for several hundred yards.

Anchorage can be had 3 miles west of the island in 12 to 15 fathoms (21.9 to 27.4 m), sand and coral bottom, with the north end of the island and the breaker on the north side of the entrance to the lagoon in range and bearing 80° true (ENE. ⅛ E. mag.). The north entrance breaker will be 1¼ miles distant. Smaller vessels can anchor closer to the entrance breakers, but the rocky bottom is very uneven. Small boats can anchor in the lagoon, as described previously. During southwest weather vessels can find anchorage from 3 to 4 miles east of the north end of the island, in from 8 to 15 fathoms (14.6 to 27. 4 m).

Directions.—Vessels may approach to within 3 miles of Lisianski Island from the northward, on courses between 90° true (E. by N. mag.) and 270° true (W. by S. mag.). Vessels should give the island a wide berth when passing southward of it, as the island itself is seldom seen from the southern limits of Neva Shoal. Approaching from the southwestward, keep about 5 miles westward of the

meridian of the island until the island bears 90° true (E. by N. mag.), when the anchorage can be approached.

Pioneer Bank lies 30 miles 97° true (E. ⅜ N. mag.) from Lisianski Island, in latitude 26°02′ N., longitude 173°26′ W. It is about 8 miles in diameter and soundings of 19 fathoms (35 m) have been obtained near its center. No breakers or dangers were observed during a preliminary survey in 1931, but as the least depth is not known, vessels should avoid the area.

PEARL AND HERMES REEF

lying about 150 miles 315° true (NW. by W. mag.) of Lisianski Island, is an extensive atoll about 40 miles in circumference, 16 miles long in an easterly direction, and 9 miles wide, on which are scattered 12 small, low islands and islets, forming a crescent open northwestward. **Southeast Island** is in latitude 27°48′ N., longitude 175°51′ W. There is an entrance to the lagoon on the northwesterly side, through which there is 1 to 6 feet (0.3 to 1.8 m) with numerous coral heads. The largest island bears 119° true (ESE. ⅜ E. mag.) from the entrance and is covered with grass and low trees. There is a boat entrance to the lagoon south of Southeast Island. Vessels can anchor outside the reef, on the northwesterly side near the entrance, in 8 to 12 fathoms (14.6 to 21.9 m), or on the easterly side of the reef. There is shoal water ½ mile from the head of the bight on the easterly side, 9 fathoms (16.5 m) being the depth reported. On the westerly side the bottom slopes off gradually to 35 fathoms (64 m) and then deepens very suddenly. There are no known dangers outside the breakers. Turtle and fish are abundant.

Current.—The current appears to set northward between Lisianski Island and Pearl and Hermes Reef.

GAMBIA BANK

lying about 35 miles 293° true (WNW. ⅞ W. mag.) of Pearl and Hermes Reef, in latitude 28°07′ N., longiude 176°38′ W., has 14 fathoms (25.6 m) over it and the bottom can be plainly seen.

MIDWAY ISLANDS (H.O. CHARTS 1952 AND 2468)

is a circular atoll about 6 miles in diameter, inclosing two islands. The narrow encircling reef is about 5 feet (1.5 m) high in places, and is almost continuous, except on the westerly side from its northwest end to Seward Roads. On this side is a flat, near the westerly edge of which are North Breakers and Middle Ground, which break continually. The whole of the barrier reef is fairly steep-to and should be given a wide berth at night.

Eastern Island, at the southeast end of the reef, is 1¼ miles long, 6 to 12 feet (1.8 to 3.7 m) high, and covered with trees, shrubbery, and coarse grass. It has a white sand beach, except its eastern point, which is coral rock. A group of ironwood trees near the northern end of the island is quite prominent.

Sand Island, on the southerly side of the reef, is 1¾ miles long and composed of white coral sand. It has a greatest elevation of 43 feet (18.1 m) in its northerly part. On the north side are the

buildings of the cable station, and on the summit of the island is Midway Islands Light, in latitude 28°12′52″ N., longitude 177°22′-46″ W. There is a flagstaff 80 feet (24.4 m) high, 56 yards south of the lighthouse. Trees have been planted around the cable buildings.

Welles Harbor is the gap in the barrier reef on the west side of the atoll, and is safe in the summer, when the northeast trades blow steadily. From October to April gales are of frequent occurrence, with always a rough westerly sea and the bar breaking almost constantly. The entrance and harbor are of coral formation, and there are numerous coral reefs and heads, which rise abruptly a few feet above the surrounding sandy bottom. Inside the reefs there is a bar of rocks and bowlders with depths of 12 to 17 feet (3.7 to 5.2 m), which is dangerous in westerly and southwesterly weather. The deepest draft entering the harbor is about 17 feet (5.2 m), but a pilot is needed when vessels draw over 15 feet (4.6 m). The northern side of the entrance to Welles Harbor is marked by **North Breakers,** a reef awash at low water, on which the sea always breaks; ½ mile northward of it is **Middle Ground,** on which the sea generally breaks. The entrance is ½ mile wide between North Breakers and the cays on the reef forming the southern side, but its navigable width is much reduced by shoals on either side.

Ranges.—Seward Roads range beacons, on sand dunes on the southerly part of Sand Island, lead through Seward Roads on a 142° true (SE. ¼ E. mag.) course to the bar, where the range intersects the Welles Harbor range. The range leads only 100 feet from the end of the shoal surrounding North Breakers, and care should be taken to go nothing northward of it when passing the shoal. It is also well to keep a little southward of the range on approaching the bar until on the Welles Harbor range. The front beacon of Seward Roads range is a black circular, slatted day mark. The rear beacon is a black pole with two boards crossed windmill fashion.

Welles Harbor range beacons on the northerly part of Sand Island, lead in the best water across the bar and through Welles Harbor to the black and white perpendicularly striped buoy nearly ⅜ mile inside the bar, course 115°30′ true (ESE. ¾ E. mag). A spot with 15 feet (4.6 m) over it lies in Seward Roads close south of the range line, with the right tangent of the outer reef on the south side of the entrance bearing about 200° true (S. ⅞ W. mag.), and there are numerous shoal spots and foul ground southward of the range to the reef. The front beacon is white wooden triangle, apex up, located on the southerly edge of a sand dune, the rear range is Midway Islands Light structure, consisting of a white house with red roof and white mast, located on the summit of Sand Island.

An inner anchorage range has been established. The front beacon is a white, square, slatted day mark on pole about 50 yards south of Welles Harbor range front beacon; the rear is Midway Islands Light. To use this range leave the Welles Harbor range about about 100 yards westward of the striped buoy and gradually haul southward, passing through the opening in the reefs south of the buoy until approaching the inner anchorage range. Then haul eastward until on this range, course 109°30′ true (E. ⅞ S. mag.).

Anchorage.—The anchorage with the best swinging room is in the middle of the basin northeast of the striped buoy. This is

exposed to westerly weather. The bottom in Welles Harbor is sand, except where otherwise marked on the chart, and is poor holding ground. The best and most convenient anchorage to the landing, which is on the north side of Sand Island, is in the middle of the basin in the eastern part of the harbor, a little over ½ mile westward from the northwest end of Sand Island, in 4¾ fathoms (8.7 m). There is scant swinging room for a vessel of any size.

Outside Anchorages.—In Seward Roads, outside the bar of Welles Harbor, there is good anchorage in favorable weather in 4½ to 5 fathoms (8.2 to 9.1 m), picking out a sandy spot to drop the anchor. Outside of North Breakers anchorage can be selected in 6 to 12 fathoms (11 to 22 m), choosing any one of the numerous sandy spots, the bottom anywhere about the island being visible up to 10 fathoms (18.3 m). A good anchorage is on the entrance range, in 9 or 10 fathoms (16.5 or 18.3 m), when North Breakers is in range with the lighthouse. Anchorage can be had in other places outside the atoll. The best, so far as bottom is concerned, is southward of the west end of Eastern Island, where a good place to drop the anchor can be chosen by inspection of the bottom. With a smooth sea there is a boat passage, with a depth of 5 feet (1.5 m), through the reef westward of Eastern Island, and a depth of 5 to 10 feet (1.5 to 3 m), thence to the northeast end of Sand Island.

Cable.—The cable between San Francisco, Honolulu, Guam, and Manila touches at Midway Islands. To avoid fouling the cables in Seward Roads, vessels should anchor northward and not within 200 yards of the Welles Harbor range line. When anchoring outside, do not anchor in any depth with the light bearing between 330° and 0° true (NW. ½ N. and N. ⅞ W. mag.). Anchorage is prohibited in an area southward and westward of Sand Island.

Supplies.—The water supply from wells at Sand Island is limited to about 6,000 gallons per day. It is lightered between a small boat wharf and the anchorages.

Winds.—During the summer months the winds are generally variable and light, either from northeast, southeast, or southwest until about the middle of July, when fresh to strong northeast trades set in and continue through July and August. Southwest winds are always accompanied with a low barometer and rain and squalls, but rain also occasionally comes with northeast and southeast winds and a high barometer. Northwest winds following southwest storms generally indicate clearing weather. During the winter months, from October to April, gales frequently occur, working around from southeast through southwest to northwest, with occasionally a few days of fine weather, but always a rough westerly sea.

Tides.—The mean range of tide at Midway Islands is 0.9 foot (0.3 m).

Currents.—There is generally little current in Welles Harbor; what little there is usually setting westward. It is reported that during heavy gales the harbor is full of strong currents, caused by the sea being forced over the reefs. The current outside generally sets northward on either side of the atoll, and with the ebb tide it slackens and sometimes reverses.

Directions.—The encircling reef is steep-to on all sides, and there are no outlying dangers. There is shoaler water, however, off the northwest side and less to mark it in that locality, and that portion

should be approached with caution. The structures on Sand Island may be seen about 12 miles under favorable conditions. The islands should never be approached at night. In Welles Harbor the best guide in general is the coral heads, which, except in cloudy weather, can be easily seen showing as dark purple against the bright blue or green of the sand, and they are always steep-to.

Approaching the entrance through Seward Roads, be guided by the ranges (see the description preceding), keeping southward of the Seward Roads range to avoid the shoal making off from North Breakers and northward of the Welles Harbor range to clear the 15-foot (4.6 m) spot near the range and the broken ground, making off from the reef on the south side of the entrance.

Crossing the bar, keep close on the Welles Harbor range on course 115° true (ESE. 5/8 E. mag.), and when about 1/4 mile inside the bar pass between two coral shoals with 14 and 15 feet (4.3 and 4.6 m) over them. When up to the vertical striped can buoy, stand northeastward to the anchorage.

If desiring to go to the inner anchorage, turn southward at the buoy, and pass between the Hook (a large coral patch) and a crescent-shaped shoal which generally shows well. Then haul eastward and follow the range on course 109° true (E. 7/8 S. mag.). Anchor near the range in the middle of the basin in 4 3/4 fathoms (8.7 m), sandy bottom.

Bank near Midway Islands.—In 1899 a bank with 82 fathoms (150 m) over it was discovered 35 miles southwestward of Midway Islands, in latitude 27°58′ N., longitude 177°55′ W.

KURE (OCEAN) ISLAND

Lying about 56 miles 280° true (W. mag.) of Midway Islands in latitude 28°25′ N., longitude 178°25′ W., is an atoll closely resembling Midway Islands in both formation and appearance. The atoll is about 15 miles in circumference, is somewhat oval in shape, and incloses a lagoon, the entrance of which is about 1 mile wide. This entrance is on the southwesterly side and is shallow. No dangers have been observed outside the reef.

Green Island, in the southeasterly part of the lagoon, is about 20 feet (6.1 m) high, covered with small shrubs, and similar to Eastern Island of the Midway Islands. Westward of it are two small sand islets. The westerly one is the largest and is about 10 feet (3 m) high. A bank with 20 to 30 fathoms (37 to 55 m) surrounds the island and extends offshore about 1 mile. The best anchorage is on the westerly side, near the northwesterly point of the breakers, in 8 to 12 fathoms (14.6 to 21.9 m), rocky bottom. From the appearance of the islands it may be assumed that they are sometimes visited by severe storms, the sand being thrown into numerous cones and pyramids. A bank (position doubtful) is placed on the charts in latitude 30°55′ N., longitude 177°30′ E. The chart gives a depth of 42 fathoms (77 m). In 1901 and 1902 this position was sounded over, and no bottom was found at 100 fathoms (183 m).

Currents.—A set to the southward has been observed between Kure and Midway Islands.

JOHNSTON (CORNWALLIS) ISLAND

is a lagoon island, the reef being about 8 miles long in a northeasterly direction, with its edges well defined by breakers at both ends and along its northwesterly side. On the reef are two islets. The larger (Johnston Island) is the southwesterly one, and is ½ mile long in an east-northeasterly direction; its easterly end is in latitude 16°45′ N., longitude 169°32′ W. The smaller one (Sand Islet) is a mere sand bank about 500 yards in diameter, lying 1 mile northeastward of Johnston Island. Both islands are grass covered.

Breakers extend northward nearly 1½ miles, and a bank surrounds the reef, extending in a southeasterly direction 5 or 6 miles, having on it depths of 5 to 10 fathoms (9.1 to 18.3 m), though many shoaler patches were seen.

Approach.—The only safe line of approach is to head for the easterly end of the large (Johnston) island on a 335° true (NW. ⅞ N. mag.) course. On this course the edge of the reef will be found in 7 fathoms (12.8 m) about 5 miles from the island, with irregular depths of 5½ to 12 fathoms (10.1 to 21.9 m), until within one mile of the island, when an anchorage can then be had. On this course shoal spots, with apparently as little as 4 fathoms (7.3 m) over them, can be seen on both sides. On account of numerous coral heads with little water over them, vessels should not attempt to go in closer than 1 mile from shore. The anchorage is sheltered from the northeast trades, but is exposed to winds from east round through south to west-southwest.

Tides.—It is high water, full and change, at 3 hours 15 minutes; mean range a little less than 2 feet (0.6 m).

Landing.—The landing is bad, but small boats can reach the beach at high water.

SCHJETMAN REEF

(existence doubtful), a breaking coral reef, level with the surface, was reported in 1868 as having been sighted in latitude 16°08′ N., longitude 178°58′ W. The reef appeared to be about 1½ miles long in a northerly direction and about ½ mile wide. This reef was searched for in 1880, but could not be found.

KRUSENSTERN ROCK

(position doubtful) was reported as a breaker in 1804 in latitude 22°15′ N. and longitude 175°37′ W. Capt. R. Suffern, of the bark *Craigerne*, reported that on June 25, 1897, his ship was on the exact position assigned to the rock, and although the weather was clear and the sea smooth, no indications of either rock or shoal water could be seen from the masthead. In 1901 breakers were reported in latitude 21°55′ N. and longitude 176°05′ W., or about 35 miles southwestward of the charted position of Krusenstern Rock.

Palmyra Island (latitude 5°52′ N., longitude 162°06′ W.) an atoll, was discovered by Captain Sawle of the American ship *Palmyra* in 1802. It had been considered part of the dependencies of the Hawaiian Islands, and upon annexation of that group to the United States became a part of the Territory of Hawaii. Palmyra Island is described in British Admiralty Pacific Islands Pilot, Vol. II.

APPENDIX

COAST PILOTS AND FIELD STATIONS OF THE COAST AND GEODETIC SURVEY

COAST PILOTS

U.S. Coast Pilot, Atlantic Coast, Section A, from St. Croix River to Cape Cod	$0.75
U.S. Coast Pilot, Atlantic Coast, Section B, from Cape Cod to Sandy Hook, including Long Island Sound	.75
U.S. Coast Pilot, Atlantic Coast, Section C, Sandy Hook to Cape Henry, including Delaware and Chesapeake Bays	.75
U.S. Coast Pilot, Atlantic Coast, Section D, Cape Henry to Key West	.75
U.S. Coast Pilot, Gulf Coast, from Key West to the Rio Grande	.75
U.S. Coast Pilot, West Indies, Puerto Rico, and Virgin Islands	.75
Inside Route Pilot, coast of New Jersey	.30
Inside Route Pilot, New York to Key West	.30
Inside Route Pilot, Key West to the Rio Grande	.50
U.S. Coast Pilot, Pacific Coast, California, Oregon, and Washington	.75
U.S. Coast Pilot, Alaska, Part I, from Dixon Entrance to Yakutat Bay	.75
U.S. Coast Pilot, Alaska, Part II, Yakutat Bay to Arctic Ocean	.75
U.S. Coast Pilot, Hawaiian Islands	.50
U.S. Coast Pilot, Philippine Islands, Part I, Luzon, Mindoro, and Visayas	.75
U.S. Coast Pilot, Philippine Islands, Part II, Palawan, Mindanao, and Sulu Archipelago	.75
Distances between United States Ports	.10

FIELD STATIONS

Boston, Mass., 808 Customhouse.
New York, N.Y., No. 6 State Street.
New Orleans, La., room 314 Customhouse.
San Francisco, Calif., room 510 Customhouse.
Seattle, Wash., room 601, Federal Office Building.
Manila, P.I., Intendencia Building.

At these stations complete files of the U.S. Coast and Geodetic Survey charts, Coast Pilots, Tide Tables, Current Tables, and other publications relating to navigation may be consulted and information affecting navigation obtained without charge. Light Lists, and Notices to Mariners are kept for sale or for free distribution to mariners. The field stations are also sales agencies for the Coast and Geodetic Survey publications. A chart catalogue, giving lists of charts, coast pilots, tide tables, and agencies of the Coast and Geodetic Survey, can be obtained from any of the field stations, or will be sent, free of charge, on application to the Coast and Geodetic Survey, Washington, D.C. Frequent changes occur in the agencies, and the list of agencies is published in the first notice each month of the Notice to Mariners.

NAVIGATIONAL AIDS AND THE USE OF CHARTS

The U.S. Coast and Geodetic Survey is charged with the survey of the coasts, harbors, and tidal estuaries of the United States and its insular possessions and issues the following publications relating to these waters as guides to navigation: Charts, Coast Pilots, Tide Tables, Current Tables, a catalogue of these publications, and Notices to Mariners, the last-named published weekly by the Bureau of Lighthouses and Coast and Geodetic Survey.

Charts bear three dates which should be understood by persons using them: (1) The date (month and year) of the edition, *printed* on the latest charts below the border in a central position; (2) the date of the latest correction to the chart plate, *printed* in the lower left-hand corner below the border; (3) the *date of isue*, *stamped* below the border and just to the left of the subtitle. Charts show all necessary corrections as to lights, beacons, buoys, and dangers, which have been received to the *date of issue*, being hand corrected since the latest date printed in the lower left-hand corner. All small but important corrections occurring subsequent to the *date of issue* of the chart are published in Notice to Mariners and should be applied by hand to the chart immediately after the receipt of the notices. The date of the edition of the chart remains unchanged until an extensive correction is made on the plate from which the chart is printed. The date is then changed and the issue is known as a new edition. When a correction, not of sufficient importance to require a new edition, is made to a chart plate, the year, month, and day are noted in the lower left-hand corner. All the notes on a chart should be read carefully, as in some cases they relate to the aids to navigation or to dangers that cannot be clearly charted. The charts are various in character, according to the objects which they are designed to subserve. The most important distinctions are the following:

1. *Sailing charts*, mostly on a scale of approximately 1:1,200,000, which exhibit the approaches to a large extent of coast, give the offshore soundings and enable the navigator to identify his position as he approaches from the open sea.

2. *General charts* of the coast, on scales of 1:400,000 and 1:200,000, intended especially for coastwise navigation.

3. *Coast charts*, on a scale of 1:80,000, by means of which the navigator is enabled to avail himself of the channels for entering the larger bays and harbors.

4. *Harbor charts*, on larger scales, intended to meet the needs of local navigation.

Note.—General charts of the Philippine Islands are on scales 1:1,600,000, 1:800,000, and 1:400,000; coast charts are on scales 1:100,000 and 1:200,000.

Coast Pilots, relating to surveyed waters of the United States, Puerto Rico, Virgin Islands, Alaska, Hawaiian Islands, and the Philippine Islands, contain full nautical descriptions of the coast, harbors, dangers, and directions for coasting and entering harbors. At intervals of about one year, supplements are issued containing the more important corrections since the publication of the volume. The supplements are printed on one side of the paper only, so that they may be cut and pasted in the appropriate places in the volume. Supplements and other corrections for any volume can be furnished, free of charge, on application to the Coast and Geodetic Survey, Washington, D.C., or any of its field stations, provided the volume itself has not ben superseded by a subsequent edition.

Tide Tables.—The Coast and Geodetic Survey Tide Tables are issued annually in advance of the year for which they are made and contain the predicted times and heights of the tide for each day in the year at the principal ports of the world, including the United States and its possessions. A table of tidal differences is given by means of which the tides at about 3,500 intermediate ports may be obtained. Separate reprints from the general Tide Tables are issued for the Atlantic and Pacific coasts of the United States and its dependencies.

Beginning with the issues for 1934, tide tables will be published in two volumes: (1) Atlantic Ocean, and (2) Pacific Ocean and Indian Ocean. In addition to the above, pocket edition tide and current tables are issued for Boston, New York, San Francisco, and Puget Sound.

Current Tables giving daily predictions for slack and strength of tidal currents and other data, are published in advance in two volumes: (1) Atlantic Coast, and (2) Pacific Coast, including Alaska and San Bernardino Strait in the Philippine Islands. There are no predictions for tidal currents in the Hawaiian Islands.

Agencies for the sale of the Charts, Coast Pilots, Tide Tables, and Current Tables of the Coast and Geodetic Survey are established in many parts of the United States and in some foreign ports. They can also be purchased in the office of the Coast and Geodetic Survey, Washington, D.C., or any of the field stations. Remittances should be made by postal money order, express order,

or check, payable to the "Coast and Geodetic Survey." Postage stamps can not be accepted. The sending of money in an unregistered letter is unsafe. Only catalogue numbers of charts need be mentioned. The catalogue of charts and other publications of the survey can be obtained free of charge on application at any of the sale agencies or to the Coast and Geodetic Survey, Washington, D.C.

Other publications.—Lists of Lights, Buoys, and other Day Marks of the United States, its insular possessions and the Great Lakes, are published by the Bureau of Lighthouses and may be purchased from its sale agencies or from the Superintendent of Documents, Washington, D.C. Notice to Mariners, relating to the same waters, is published weekly by the Bureau of Lighthouses and Coast and Geodetic Survey; this publication can be obtained free of charge on application to the Division of Publications, Department of Commerce, Washington, D.C.

REMARKS ON THE USE OF CHARTS

Accuracy of charts.—The value of a chart depends upon the character and accuracy of the survey on which it is based, and the larger the scale of the chart the more important do these become. In these respects the source from which the information has been compiled is a good guide. This applies particularly to the charts of the Alaska Peninsula, Aleutian Islands, Arctic Ocean and part of Bering Sea. The early Russian surveys were not made with great accuracy, and until they are replaced by later surveys these charts must be used with caution.

With respect to these regions the fullness or scantiness of the soundings is another method of estimating the completeness of a chart. When the soundings are sparse or unevenly distributed it may be taken for granted that the survey was not in great detail. A wide berth should therefore be given to every rocky shore or patch. and this rule should invariably be followed, viz, that instead of considering a coast to be clear, unless it is shown to be foul, the contrary should be assumed.

With respect to a well-surveyed coast only a fractional part of the soundings obtained are shown on the chart, a sufficient number being selected to clearly indicate the contour of the bottom. When the bottom is uneven the soundings will be found grouped closely together, and when the slopes are gradual fewer soundings are given. Each sounding represents an actual measure of depth and location at the time the survey was made. Shores and shoals where sand and mud prevail and especially bar harbors and the entrances of bays and rivers exposed to strong tidal currents and a heavy sea, are subject to continual change of a greater or less extent, and important ones may have taken place since the date of the last survey. In localities which are noted for frequent and radical changes, such as the entrance to a number of estuaries on the Atlantic Gulf, and Pacific coasts, notes are printed on the charts calling attention to the fact.

It should also be remembered that in coral regions and where rocks abound it is always possible that a survey with lead and line, however detailed, may have failed to find every small obstruction. For these reasons when navigating such waters the customary sailing lines and channels should be followed, and those areas avoided where the irregular and sudden changes in depth indicate conditions which are associated with pinnacle rocks or coral heads.

Dredged channels.—These are generally shown upon the chart by two broken lines to represent the side limits of the improvement together with the depth and date. The depth is the controlling depth through the channel on the date charted and does not mean that this depth obtains over the full width of the channel, nor that the depth has not subsequently changed due to either shoaling or dredging. These changes are often of frequent occurrence; therefore, when vessels' drafts approximate the charted depth of a dredged channel local information as to conditions should be obtained before entering.

Danger curves.—The depth curves will be found useful in giving greater prominence to outlying dangers. It is a good plan to trace out with a colored pencil the curve next greater than the draft of the vessel using the chart and regard this as a "danger curve," which is not to be crossed without precaution. Isolated soundings shoaler than surrounding depths should be avoided, as there is always the possibility that the shoalest spot may not have been found.

Caution in using small-scale charts.—It is obvious that dangers to navigation cannot be shown with the same amount of detail on small-scale charts as on those of larger scale; therefore in approaching the land or dangerous banks

regard should be had to the scale of the chart and the largest scale chart available should be used. A small error in laying down a position means only yards on a large-scale chart, whereas on a small scale the same amount of displacement means large fractions of a mile. For the same reason bearings to near objects should be used in preference to objects farther off, although the latter may be more prominent, as a small error in bearing or in laying it down on the chart has a greater effect in misplacing the position the longer the line to be drawn.

Distortion of printed charts.—All Coast and Geodetic Survey charts are now printed by lithography on dry paper and have little, if any, distortion. A lithographed chart may be distinguished from a plate-printed chart by the feel of the surface, the former being smooth while the latter is rough. Lithographed charts also are usually tinted in colors while the others are in black and white.

Buoys.—Too much reliance should not be placed on buoys always maintaining their exact position, especially when in exposed positions. It is safer, when possible, to navigate by bearings or angles to fixed objects on shore and by the use of soundings.

Lighted buoys and other unwatched lights can not be implicitly relied on; the light may be altogether extinguished or, if intermittent, the apparatus may get out of order.

Lights.—The distance given in the Light Lists, Coast Pilots, and on the charts for the visibility of lights are computed for a height of 15 feet (4.6 m.) for the observer's eye. The table of distances of visibility due to height, published in the Light List, affords a means of ascertaining the effect of a greater or less height of the eye. The glare of a powerful light is often seen far beyond the limit of visibility of the actual rays of the light, but this must not be confounded with the true range. Again, refraction may often cause a light to be seen farther than under ordinary circumstances.

As the range of visibility increases with the elevation of the observer, it is often possible to obtain a bearing before the light is sighted from the bridge by sighting the light from aloft, noting a star in range with it and then obtaining a bearing of the star, with compass or pelorus. The actual power of a light should be considered when expecting to make it in thick weather. A weak light is easily obscured by haze, and no dependence can be placed on its being seen. The power of a light can be estimated by its candlepower as given in the Light Lists and in some cases by noting how much its visibility in clear weather falls short of the range due to the height at which it is placed. Thus a light standing 200 feet above the sea and recorded as visible only 10 miles in clear weather is manifestly of little brilliancy, as its height would permit it to be seen over 20 miles if of sufficient power.

Fog signals.—Sound is conveyed in a very capricious way through the atmosphere. Apart from the wind, large areas of silence have been found in different directions and at different distances from the origin of the sound signal, even in clear weather. Therefore too much confidence should not be felt as to hearing a fog signal. The apparatus, moreover, for sounding the signal may require some time before it is in readiness to act. A fog often creeps imperceptibly toward the land and it is not observed by those at a lighthouse until it is upon them, whereas a vessel may have been in it for many hours while approaching the land. In such a case no signal may be sounded. When sound travels against the wind it may be thrown upward; in such a case a man aloft might hear it when it is inaudible on deck. The conditions for hearing a signal will vary at the same station within short intervals of time. Mariners must not, therefore, judge their distance from a fog signal by the force of the sound and must not assume that a signal is not sounding because they do not hear it. Taken together, these facts should induce the utmost caution when nearing the land or danger in fog. The lead is generally the only safe guide and should be faithfully used.

In regions where the shores are high and rocky the echo of the whistle frequently gives warning of too close an approach to shore. In narrow passages it is often possible to keep in mid-channel by directing the course so that the echoes from both shores are heard at approximately the same time.

Tides.—A knowledge of the tide, or vertical rise and fall of the water, is of great and direct importance whenever the depth at low water approximates to or is less than the draft of the vessel, and wherever docks are constructed so as to be entered and left near the time of high water. But under all

conditions such knowledge may be of indirect use, as it often enables the mariner to estimate in advance whether at a given time and place the current will be running flood or ebb. In using the tables slack water should not be confounded with high or low tide, nor a flood or ebb current with a rising or falling tide. In some localities the tide may be at a high or low water stand while the current is at its maximum velocity.

The **Tide Tables** published by the Coast and Geodetic Survey give the predicted times and heights of high and low waters for most of the principal ports of the world and tidal differences and constants for obtaining the tides at all important ports.

Plane of reference for soundings on charts.—For the Atlantic coast of the United States and Puerto Rico the plane of reference for soundings is the mean of all low waters; for the Pacific coat of the United States and Alaska, and for the Hawaiian and Philippine Islands, it is the mean of the lower low waters. For the Atlantic coast of the Canal Zone, Panama, the plane of reference for soundings is mean low water, and for the Pacific coast of the same it is low-water springs. For foreign charts many different planes of reference are in use, but that most frequently adopted is low-water springs.

It should be remembered that whatever plane of reference is used for a chart, there may be times when the tide falls below it. When the plane is mean low water or mean lower low water, there will generally be as many low waters or lower low waters below those planes as above them; also the wind may at times cause the water to fall below the plane of reference.

Tidal currents.—In navigating coasts where the tidal range is considerable, special caution is necessary. It should be remembered that there are indrafts into all bays and bights, although the general set of the current is parallel to the shore, and that the effect of a cross current is greater on a vessel running slowly than when at full speed. The turn of the tidal current offshore is seldom coincident with the time of high and low water on the shore.

At the entrance to most harbors without important tributaries or branches the current turns at or soon after the time of high and low water within. The diurnal inequality in the velocity of current will be proportionately but half as great as in the height of the tides. Hence, although the heights of the tide may be such as to cause the surface of the water to vary but little in level for 10 or 12 hours, the ebb and flow will be much more regular in occurrence. A swift current often occurs in narrow openings between two bodies of water, because the water at a given instant may be at different levels. Along most shores not seriously affected by bays, tidal rivers, etc., the current usually turns soon after high and low waters.

The swiftest current in straight portions of tidal rivers is usually in the mid-channel, but in curved portions the strongest current is toward the outer edge of the curve. Counter currents and eddies may occur near the shore of straits, especially in bights and near points.

Tide rips and swirls occur in places where strong currents occur, caused by a change in the direction of the current, and especially over shoals or in places where the bottom is uneven. Such places should be avoided if exposed also to a heavy sea, especially with the wind opposing the current. When these conditions are at the worst, the water is broken into heavy, choppy seas from all directions, which board the vessel, and also make it difficult to keep control, owing to the baring of the propeller and rudder.

The **current tables** published by the Coast and Geodetic Survey give the predicted times of slack water and other current data for a number of places on the Pacific and Atlantic coasts of North America.

Current arrows on charts show only the usual or mean direction of a tidal stream or current. It must not be assumed that the direction of the current will not vary from that indicated by the arrow. In the same manner the velocity of the current constantly varies with circumstances, and the rate given on the chart is a mean value, corresponding to an average range of tide. At some stations but few observations have been made.

Fixing position.—The most accurate method available to the navigator for fixing a position relative to the shore is by plotting with a protractor sextant angles between well-defined objects on the chart. This method, based on the "*three-point problem*" of geometry, should be in general use.

In many narrow waters where the objects may yet be at some distance, as in coral harbors or narrow passages among mud banks, navigation by sextant and protractor is invaluable, as a true position can in general be ob-

tained only by its means. Positions by bearings are too rough to depend upon, and a small error in either taking or plotting a bearing might under such circumstances put the ship ashore. For its successful employment it is necessary, first, that the objects be well chosen, and second, that the observer be skillful and rapid in his use of the sextant. The latter is only a matter of practice.

Near objects should be used either for bearing or angles for the position in preference to distant ones, although the latter may be more prominent, as a small error in the bearing or angle or in laying it on the chart has a greater effect in misplacing the position the longer the line to be drawn. On the other hand, distant objects should be used for direction because less affected by a small error or change of position. The 3-arm protractor consists of a graduated circle with one fixed and two movable radial arms. The zero of the graduation is at the fixed arm, and by turning the movable arms each one can be set at any desired angle with reference to the fixed arm.

To plot a position the two angles observed between the three selected objects are set on the instrument, which is then moved over the chart until the three beveled edges in case of a metal instrument, or the radial lines in the case of a transparent or celluloid instrument, pass respectively and simultaneously through the three objects. The center of the instrument will then mark the ship's position, which may be pricked on the chart or marked with a pencil point through the center hole. The tracing-paper protractor, consisting of a graduated circle printed on tracing paper, can be used as a substitute for the brass or celluloid instrument. The paper protractor also permits the laying down for simultaneous trial of a number of angles in cases of fixing important positions. Plain tracing paper may also be used if there are any suitable means of laying off the angles.

The value of a determination depends greatly on the relative positions of the objects observed. If the position sought lies on the circle passing through the three objects, it will be indeterminate, as it will plot all around the circle. An approach to this condition, which is called a "revolver", must be avoided. In case of doubt, select from the chart three objects nearly in a straight line or with the middle object nearest the observer. Near objects are better than distant ones, and in general, up to 90°, the larger the angles the better, remembering always that large as well as small angles may plot on or near the circle and hence be worthless. If the objects are well situated, even very small angles will give for navigating purposes a fair position, when that obtained by bearings of the same objects would be of little value.

Accuracy requires that the two angles be simultaneous. If under way, and there is but one observer, the angle that changes less rapidly may be observed both before and after the other angle and the proper value obtained by interpolation. A single angle and a range, give in general, an excellent fix, easily obtained and plotted.

The compass.—It is not intended that the use of the compass to fix the position should be given up. There are many circumstances in which it may be usefully employed, but errors more readily creep into a position so fixed. Where accuracy of position is desired, angles should invariably be used, such as the fixing of a rock or shoal or of additions to a chart, as fresh soundings or new buildings. In such cases angles should be taken to several objects, the more the better, but five objects is a good number, as the four angles thus obtained prevent any errors. When only two objects are visible, a sextant angle can be used to advantage with the compass bearings and a better fix obtained than by two bearings alone.

Doubling the angle on the bow.—The method of fixing the position by doubling the angle on the bow is invaluable. The ordinary form of it, the so-called bow and beam bearing, the distance from the object at the latter position being the distance run between the times of taking the two bearings, gives the maximum of accuracy and is an excellent fix for a departure, but does not insure safety, as the object observed and any dangers off it are abeam when the position is obtained. By taking the bearing at two points and four points on the bow a fair position is obtained before the object is passed, the distance of the latter at the second position being, as before, equal to the distance run in the interval allowing for current. Taking afterwards the beam bearing gives, with slight additional trouble, the distance of the object when abeam. Such beam bearings and distances, with the times, should be continuously recorded as fresh departures, the importance of which will be appreciated in case of being suddenly shut in by fog. A graphic solution of the problem for any two bearings of the same object is frequently used. The two bearings are

drawn on the chart, and the course is then drawn by means of the parallel rulers, so that the distance as measured from the chart between the lines is equal to the distance made good by the vessel between the times of taking the bearings.

Danger angle.—The utility of the danger angle in passing outlying rocks or dangers should not be forgotten. In employing the horizontal danger angle, however, charts compiled from early Russian sources, referred to in a preceding paragraph, should not be used.

Soundings.—In thick weather, when near or approaching the land or danger, soundings should be taken continuously and at regular intervals, and with the character of the bottom systematically recorded. By marking the soundings on tracing paper, according to the scale of the chart, along a line representing the track of the ship and then moving the paper over the chart parallel with the course until the observed soundings agree with those of the chart, the ship's position will in general be quite well determined.

Echo sounding.—This method of obtaining soundings is becoming extensively used. Its advantages lie in the fact that rapid and almost instantaneous soundings can be had while the vessel is running at full speed, and the navigator thereby knows at all times the depth of water under his keel. Two types of instruments have been brought out. In one type the returning echo is flashed on a revolving plate and the depth read by an adjacent scale, while with the other type the depths are recorded on a graph.

By means of echo sounding a vessel can follow the 50- or 100-fathom curve with ease, and in such localities as the Pacific coast and Alaska dangerous points and capes can be rounded in thick weather with utmost safety.

Echo sounding has been developed to such an extent that it is now used by the surveying vessels of the Coast and Geodetic Survey, and has practically replaced the use of the pressure tube.

Use of sounding tubes.—Although of undoubted value as a navigational instrument, the sounding tube is subject to certain defects which, operating singly or in combinations, may give results so misleading as to seriously endanger the vessel, whose safety is entirely dependent upon an accurate knowledge of the depths. There are various types of tubes in common use which are too well known to require detailed description here. They are all based on the principle that the column of air in the tube will be compressed in proportion to the depth to which the tube is lowered in the water. The principle is sound theoretically, but in practice there are several sources of mechanical errors which affect the result in proportion to the depth of water determined. The most important sources of errors are as follows:

(*a*) Inherent: Those which occur as a result of permanent defects in the tube, such as the variation of the bore from a true cylinder, variation in the thickness of the cap, etc.

(*b*) External: Those which occur as a result of the conditions under which the sounding was taken, variations of temperature or barometric pressure from the normal, etc.

(*c*) Accidental: Those which affect a single sounding due to the failure of the tube to register properly, leakage of air, loss of water from leaky valve, errors due to the presence of salt in the tube, etc.

Before undertaking the sounding necessary to make any particular landfall the vessel should be stopped for an up-and-down cast of the lead in order to test the accuracy under the prevailing conditions of the tubes which are to be used. For this purpose it is not necessary to get bottom; simply run out 60 to 80 fathoms of wire and then see how closely the tubes register that amount. A number of tubes can be sent down at one time, and it is then possible to select one or two which register most nearly correct. The accidental errors are probably the most serious of the three types, both because they are apt to be larger in amount and because it is impossible to foresee when they will occur. It should be kept in mind that tubes which have been working properly for a number of soundings may suddenly develop errors, and for this reason the mariner must beware of overconfidence in the tubes.

Sumner's method.—Among astronomic methods of fixing a ship's position the great utility of Sumner's method or one of its many modifications should be well understood, and this method should be in constant use. The Sumner line—that is, the line drawn through the two positions obtained by working the chronometer observation for longitude with two assumed latitudes, or by drawing through the position obtained with one latitude a line at right angles to the bearing of the body as obtained from the azimuth tables—gives at times

invaluable information, as the ship must be somewhere on that line, provided the chronometer is correct. If directed toward the coast, it marks the bearing of a definite point; if parallel with the coast, the distance of the latter is shown. Thus the direction of the line may often be usefully taken as a course. A sounding at the same time with the observation may often give an approximate position on the line. A very accurate position can be obtained by observing two or more stars at morning or evening twilight, at which time the horizon is well defined. The Summer lines thus obtained will, if the bearings of the stars differ three points or more, give an excellent result. A star or planet at twilight and the sun afterwards or before may be combined; also two observations of the sun with sufficient interval to admit of a considerable change of bearing. In these cases one of the lines must be moved for the run of the ship. The moon is often visible during the day, and in combination with the sun gives an excellent fix.

Position line by means of tables.—The Sumner line of position furnished ready to lay down on the chart may be derived from the tables of Simultaneous Hour Angle and Azimuth of Celestial Bodies, published by the Hydrographic Office as Publication No. 203. By means of these tables all calculations are avoided, but they are not recommended for use within an hour of the meridian, when the Marc St. Hilaire Method of Ex-Meridian Tables should be substituted.

Position line by Marc St. Hilaire or calculated altitude method.—By this method the altitude of the celestial body is calculated for the assumed position, and the difference between the observed and calculated altitudes is laid off toward or away from the assumed position, according to sign, along the azimuth of the observed body. The line of position is then drawn through the new point in a direction normal to the azimuth of the celestial body. This method has certain advantages, the principal one being that the solution is strong even when the body is near the meridian. Full description of this method will be found in any epitome of navigation.

Radio direction-finder bearings and positions are especially valuable at night and during fog or thick weather when other observations are not obtainable. For practical navigating purposes radio waves may be regarded as traveling in a straight line from the sending station to the receiving station. Instruments for determining the bearing of this line are now available. The necessary observations may be divided into two general classes: First, where the bearing of the ship's radio call is determined by one, two, or more radio stations on shore and the resulting bearing or position is reported to the vessel; secondly, where the bearing of one or more known radio stations is determined on the vessel itself and plotted as a line of position or as cross bearings. Experiments show that these bearings can be determined with a probable error of less than 2°, and the accuracy of the resulting position is largely dependent on the skill and care of the observer. It must be remembered, however, that these lines are parts of great circles, and if plotted as straight lines on a Mercator chart a considerable error may result when the ship and shore stations are a long distance apart. The bearings may be corrected for this distortion as explained on page 8.

Radio bearings may be combined with position lines obtained from astronomic observations and used in ways very similar to the well-known Sumner line when avoiding dangerous shoals or when making the coast.

Radiobeacons.—The U.S. Lighthouse Service now maintains and operates radiobeacons at a large number of lighthouses and lightships. In fog or thick weather these radiobeacons send distinctive signals and ships equipped with radio compasses may readily obtain bearings on these beacons. For a detailed description, see page 7.

Change of variation of the compass.—The gradual change in the variation must not be forgotten in laying down positions by bearing on charts. The magnetic compasses placed on the charts for the purpose of facilitating plotting become in time slightly in error, and in some cases, such as with small scales, or when the lines are long, the displacement of position from neglect of this change may be of importance. The compasses are replotted for ever new edition if the error is appreciable. Means for determining the amount of this error are provided by printing the date of constructing the compass and the annual change in variation near its edge.

The change in the magnetic variation in passing along some parts of the coast of the United States is so rapid as to materially affect the course of a vessel unless given constant attention. This is particularly the case in New

England and parts of Alaska, where the lines of equal magnetic variation are close together and show rapid changes in magnetic variation from place to place, as indicated by the large differences in variation given on neighboring compass roses.

Local magnetic disturbance.—The term "local magnetic disturbance" or "local attraction" has reference only to the effects on the compass of magnetic masses external to the ship. Observation shows that such disturbance of the compass in a ship afloat is experienced only in a few places. Magnetic laws do not permit of the supposition that it is the visible land which causes such disturbance, because the effect of a magnetic force diminishes in such rapid proportion as the distance from it increases that it would require a local center of magnetic force of an amount absolutely unknown to affect a compass half a mile distant.

Such deflection of the compass are due to magnetic minerals in the bed of the sea under the ship, and when the water is shallow and the force strong the compass may be temporarly deflected when passing over such a spot, but the area of disturbance will be small, unless there are many centers near together. The law which has hitherto been found to hold good as regards local magnetic disturbance is that north of the magnetic equator the north end of the compass needle is attracted toward any center of disturbance; south of the magnetic equator it is repelled. It is very desirable that whenever an area of local magnetic disturbance is noted the position should be fixed and facts reported as far as they can be ascertained.

USE OF OIL FOR MODIFYING THE EFFECT OF BREAKING WAVES

Many experiences of late years have shown that the utility of oil for this purpose is undoubted and the application simple. The following may serve for the guidance of seamen, whose attention is called to the fact that a very small quantity of oil skillfully applied may prevent much damage both to ships (especially of the smaller classes) and to boats by modifying the action of breaking seas. The principal facts as to the use of oil are as follows:

1. On free waves—that is, waves in deep water—the effect is greatest.
2. In a surf, or waves breaking on a bar, where a mass of liquid is in actual motion in shallow water, the effect of the oil is uncertain, as nothing can prevent the larger waves from breaking under such circumstances, but even here it is of some service.
3. The heaviest and thickest oils are most effectual. Refined kerosene is of little use; crude petroleum is serviceable when nothing else is obtainable; but all animal and vegetable oils, and generally waste oil from the engines, have great effect.
4. A small quantity of oil suffices, if applied in such a manner as to spread to windward.
5. It is useful in a ship or boat, either when running or lying-to or in wearing.
6. No experiences are related of its use when hoisting a boat at sea or in a seaway, but it is highly probable that much time would be saved and injury to the boat avoided by its use on such occasions.
7. In cold water the oil, being thickened by the lower temperature and not being able to spread freely, will have its effect much reduced. This will vary with the description of oil used.
8. For a ship at sea the best method of application appears to be to hang over the side, in such a manner as to be in the water, small canvas bags, capable of holding from 1 to 2 gallons of oil, the bags being pricked with a sail needle to facilitate leakage of the oil. The oil is also frequently distributed from canvas bags or oakum inserted in the closet bowls. The positions of these bags should vary with the circumstances. Running before the wind, they should be hung on either bow; for example, from the cathead and allowed to tow in the water. With the wind on the quarter the effect seems to be less than in any other position, as the oil goes astern while the waves come up on the quarter. Lying-to, the weather bow, and another position farther aft seems the best places from which to hang the bags, using sufficient line to permit them to draw to windward while the ship drifts.
9. Crossing a bar with a flood tide, to pour oil overboard and allow it to float in ahead of the boat, which would follow with a bag towing astern, would appear to be the best plan. As before remarked, under these circum-

stances the effect cannot be so much trusted. On a bar with the ebb tide running it would seem to be useless to try oil for the purpose of entering.

10. For boarding a wreck it is recommended to pour oil overboard to windward of her before going alongside. The effect in this must greatly depend upon the set of the current and the circumstances of the depth of water.

11. For a boat riding in bad weather from a sea anchor it is recommended to fasten the bag to an endless line rove through a block on the sea anchor, by which means the oil can be diffused well ahead of the boat and the bag readily hauled on board for refilling if necessary.

RULES OF THE ROAD—INTERNATIONAL RULES TO PREVENT COLLISIONS OF VESSELS

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following regulations for preventing collisions at sea shall be followed by all public and private vessels of the United States upon the high seas and in all waters connected therewith navigable by seagoing vessels:

Preliminary

In the following rules every steam vessel which is under sail and not under steam is to be considered a sailing vessel, and every vessel under steam, whether under sail or not, is to be considered a steam vessel.

The word "steam vessel" shall include any vessel propelled by machinery.

A vessel is "under way," within the meaning of these rules, when she is not at anchor, or made fast to the shore or aground.

RULES CONCERNING LIGHTS, AND SO FORTH

The word "visible" in these rules when applied to lights shall mean visible on a dark night with a clear atmosphere.

Article 1. The rules concerning lights shall be complied with in all weathers from sunset to sunrise, and during such time no other lights which may be mistaken for the prescribed lights shall be exhibited.

Art. 2. A steam vessel when under way shall carry—(a) On or in front of the foremast, or if a vessel without a foremast, then in the fore part of the vessel, at a height above the hull of not less than twenty feet, and if the breadth of the vessel exceeds twenty feet, then at a height above the hull not less than such breadth, so, however, that the light need not be carried at a greater height above the hull than forty feet, a bright white light, so constructed as to show an unbroken light over an arc of the horizon of twenty points of the compass, so fixed as to throw the light ten points on each side of the vessel, namely, from right ahead to two points abaft the beam on either side, and of such a character as to be visible at a distance of at least five miles.

(b) On the starboard side a green light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the starboard side, and of such a character as to be visible at a distance of at least two miles.

(c) On the port side a red light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the port side, and of such a character as to be visible at a distance of at least two miles.

(d) The said green and red side lights shall be fitted with inboard screens projecting at least three feet forward from the light, so as to prevent these lights from being seen across the bow.

(e) A steam vessel when under way may carry an additional white light similar in construction to the light mentioned in subdivision (a). These two lights shall be so placed in line with the keel that one shall be at least fifteen feet higher than the other, and in such a position with reference to each other that the lower light shall be forward of the upper one. The vertical distance between these lights shall be less than the horizontal distance.

Art. 3. A steam vessel when towing another vessel shall, in addition to her side lights, carry two bright white lights in a vertical line one over the other, not less than six feet apart, and when towing more than one vessel shall carry

an additional bright white light six feet above or below such lights, if the length of the tow measuring from the stern of the towing vessel to the stern of the last vessel towed exceeds six hundred feet. Each of these lights shall be of the same construction and character, and shall be carried in the same position as the white light mentioned in article 2 (a), excepting the additional light, which may be carried at a height of not less than fourteen feet above the hull.

Such steam vessel may carry a small white light abaft the funnel or aftermast for the vessel towed to steer by, but such light shall not be visible forward of the beam.

Art. 4. (a) A vessel which from any accident is not under command shall carry at the same height as a white light mentioned in article 2 (a), where they can best be seen, and if a steam vessel in lieu of that light two red lights, in a vertical line one over the other, not less than six feet apart, and of such a character as to be visible all around the horizon at a distance of at least two miles; and shall by day carry in a vertical line one over the other, not less than six feet apart, where they can best be seen, two black balls or shapes, each two feet in diameter.

(b) A vessel employed in laying or in picking up a telegraph cable shall carry in the same position as the white light mentioned in article 2 (a), and if a steam vessel in lieu of that light three lights in a vertical line one over the other not less than six feet apart. The highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of such a character as to be visible all around the horizon at a distance of at least two miles. By day she shall carry in a vertical line, one over the other, not less than six feet apart, where they can best be seen, three shapes not less than two feet in diameter, of which the highest and lowest shall be globular in shape and red in color, and the middle one diamond in shape and white.

(c) The vessels referred to in this article, when not making way through the water shall not carry the side lights, but when making way shall carry them.

(d) The lights and shapes required to be shown by this article are to be taken by other vessels as signals that the vessel showing them is not under command and cannot therefore get out of the way.

These signals are not signals of vessels in distress and requiring assistance. Such signals are contained in article 31.

Art. 5. A sailing vessel under way and any vessel being towed shall carry the same lights as are prescribed by article 2 for a steam vessel under way with the exception of the white lights mentioned therein, which they shall never carry.

Art. 6. Whenever, as in the case of small vessels under way during bad weather, the green and red side lights cannot be fixed, these lights shall be kept at hand, lighted and ready for use; and shall, upon the approach of or to other vessels, be exhibited on their respective sides in sufficient time to prevent collision, in such manner as to make them most visible, and so that the green light shall not be seen on the port side nor the red light on the starboard side, nor, if practicable, more than two points abaft the beam on their respective sides. To make the use of these portable lights more certain and easy, the lanterns containing them shall each be painted outside with the color of the light they respectively contain, and shall be provided with proper screens.

Art. 7. Steam vessels of less than forty, and vessels under oars or sails of less than twenty tons gross tonnage, respectively, and rowing boats, when under way, shall not be required to carry the lights mentioned in article 2 (a), (b), and (c), but if they do not carry them they shall be provided with the following lights:

First. Steam vessels of less than forty tons shall carry—

(a) In the fore part of the vessel, or on or in front of the funnel, where it can best be seen, and at a height above the gunwale of not less than nine feet, a bright white light constructed and fixed as prescribed in article 2 (a), and of such a character as to be visible at a distance of at least two miles.

(b) Green and red side lights constructed and fixed as prescribed in article 2 (b) and (c), and of such a character as to be visible at a distance of at least one mile, or a combined lantern showing a green light and a red light from right ahead to two points abaft the beam on their respective sides. Such lanterns shall be carried not less than three feet below the white light.

Second. Small steamboats, such as are carried by seagoing vessels, may carry the white light at a less height than nine feet above the gunwale, but it shall be carried above the combined lantern mentioned in subdivision 1 (b).

Third Vessels under oars or sails of less than twenty tons shall have ready at hand a lantern with a green glass on one side and a red glass on the other, which, on the approach of or to other vessels, shall be exhibited in sufficient time to prevent collision, so that the green light shall not be seen on the port side nor the red light on the starboard side.

Fourth. Rowing boats, whether under oars or sail, shall have ready at hand a lantern showing a white light which shall be temporarily exhibited in sufficient time to prevent collision.

The vessels referred to in this article shall not be obliged to carry the lights prescribed by article 4 (a) and article 11, last paragraph.

Art. 8. Pilot vessels when engaged on their station on pilotage duty shall not show the lights required for other vessels, but shall carry a white light at the masthead, visible all around the horizon, and shall also exhibit a flare-up light or flare-up lights at short intervals, which shall never exceed fifteen minutes.

On the near approach of or to other vessels they shall have their side lights lighted ready for use, and shall flash or show them at short intervals, to indicate the direction in which they are heading, but the green light shall not be shown on the port side nor the red light on the starboard side.

A pilot vessel of such a class as to be obliged to go alongside of a vessel to put a pilot on board may show the white light instead of carrying it at the masthead, and may, instead of the colored lights above mentioned, have at hand ready for use, a lantern with green glass on the one side and red glass on the other, to be used as prescribed above.

Pilot vessels, when not engaged on their station on pilotage duty, shall carry lights similar to those of other vessels of their tonnage.

A steam pilot vessel, when engaged on her station on pilotage duty and in waters of the United States, and not at anchor, shall, in addition to the lights required for all pilot boats, carry at a distance of eight feet below her white masthead light a red light, visible all around the horizon and of such a character as to be visible on a dark night with a clear atmosphere at a distance of at least two miles, and also the colored side lights required to be carried by vessels when under way.

When engaged on her station on pilotage duty and in waters of the United States, and at anchor, she shall carry in addition to the lights required for all pilot boats the red light above mentioned, but not the colored side lights. When not engaged on her station on pilotage duty, she shall carry the same lights as on other steam vessels.

Art. 9. Fishing vessels and fishing boats, when under way and when not required by this article to carry or show the lights hereinafter specified shall carry or show the lights prescribed for vessels of their tonnage under way.

(a) Open boats, by which is to be understood boats not protected from the entry of sea water by means of a continuous deck, when engaged in any fishing at night, with outlying tackle extending not more than one hundred and fifty feet horizontally from the boat into the seaway, shall carry one all-around white light.

Open boats, when fishing at night, with outlying tackle extending more than one hundred and fifty feet horizontally from the boat into the seaway, shall carry one all-around white light, and in addition, on approaching or being approached by other vessels, shall show a second white light at least three feet below the first light and at a horizontal distance of at least five feet away from it in the direction in which the outlying tackle is attached.

(b) Vessels and boats, except open boats as defined in subdivision (a), when fishing with drift nets, shall, so long as the nets are wholly or partly in the water, carry two white lights where they can best be seen. Such lights shall be placed so that the vertical distance between them shall be not less than six feet and not more than fifteen feet, and so that the horizontal distance between them, measured in a line with the keel, shall be not less than five feet and not more than ten feet. The lower of these two lights shall be in the direction of the nets, and both of them shall be of such a character as to show all around the horizon, and to be visible at a distance of not less than three miles.

Within the Mediterranean Sea and in the seas bordering the coasts of Japan and Korea sailing fishing vessels of less than twenty tons gross tonnage shall not be obliged to carry the lower of these two lights. Should they, however, not carry it, they shall show in the same position (in the direction of the net or gear) a white light, visible at a distance of not less than one sea mile, on the approach of or to other vessels.

(c) Vessels and boats, except open boats as defined in subdivision (a), when line fishing with their lines out and attached to or hauling their lines, and when not at anchor or stationary within the meaning of subdivision (h), shall carry the same lights as vessels fishing with drift nets. When shooting lines, or fishing with towing lines, they shall carry the lights prescribed for a steam or sailing vessel under way, respectively.

Within the Mediterranean Sea and in the seas bordering the coasts of Japan and Korea, sailing fishing vessels of less than twenty tons gross tonnage shall not be obliged to carry the lower of these two lights. Should they, however, not carry it, they shall show in the same position (in the direction of the lines) a white light visible at a distance of not less than one sea mile on the approach of or to other vessels.

(d) Vessels when engaged in trawling, by which is meant the dragging of an apparatus along the bottom of the sea—

First. If steam vessels, shall carry in the same position as the white light mentioned in article 2 (a) a tricolored lantern so constructed and fixed as to show a white light from right ahead to two points on each bow, and a green light and a red light over an arc of the horizon from two points on each bow to two points abaft the beam on the starboard and port sides, respectively; and not less than six nor more than twelve feet below the tricolored lantern a white light in a lantern, so constructed as to show a clear, uniform, and unbroken light all around the horizon.

Second. If sailing vessels, shall carry a white light in a lantern, so constructed as to show a clear, uniform, and unbroken light all around the horizon, and shall also, on the approach of or to other vessels, show where it can best be seen a white flare-up light or torch in sufficient time to prevent collision.

All lights mentioned in subdivision (d) first and second shall be visible at a distance of at least two miles.

(e) Oyster dredgers and other vessels fishing with dredge nets shall carry and show the same lights as trawlers.

(f) Fishing vessels and fishing boats may at any time use a flare-up light in addition to the lights which they are by this article required to carry and show, and they may also use working lights.

(g) Every fishing vessel and every fishing boat under one hundred and fifty feet in length, when at anchor, shall exhibit a white light visible all around the horizon at a distance of at least 1 mile.

Every fishing vessel of 150 feet in length or upward, when at anchor, shall exhibit a white light visible all around the horizon at a distance of at least 1 mile, and shall exhibit a second light as provided for vessels of such length by article 11.

Should any such vessel, whether under 150 feet in length or of 150 feet in length or upward, be attached to a net or other fishing gear, she shall on the approach of other vessels show an additional white light at least three feet below the anchor light, and at a horizontal distance of at least five feet away from it in the direction of the net or gear.

(h) If a vessel or boat when fishing becomes stationary in consequence of her gear getting fast to a rock or other obstruction, she shall in daytime haul down the day signal required by subdivision (k); at night show the light or lights prescribed for a vessel at anchor; and during fog, mist, falling snow, or heavy rainstorms make the signal prescribed for a vessel at anchor. (See subdivision (d) and the last paragraph of article 15.)

(i) In fog, mist, falling snow, or heavy rainstorms drift-net vessels attached to their nets, and vessels when trawling, dredging, or fishing with any kind of dragnet, and vessels line fishing with their lines out, shall, if of twenty tons gross tonnage or upward, respectively, at intervals of not more than one minute make a blast; if steam vessels, with the whistle or siren, and if sailing vessels, with the foghorn, each blast to be followed by ringing the bell. Fishing vessels and boats of less than twenty tons gross tonnage shall not be obliged to give the above-mentioned signals; but if they do not, they shall make some other efficient sound signal at intervals of not more than one minute.

(k) All vessels or boats fishing with nets or lines or trawls, when under way, shall in daytime indicate their occupation to an approaching vessel by displaying a basket or other efficient signal where it can best be seen. If vessels or boats at anchor have their gear out, they shall, on the approach of other vessels, show the same signal on the side on which those vessels can pass.

The vessels required by this article to carry or show the lights hereinbefore specified shall not be obliged to carry the lights prescribed by article 4 (a) and the last paragraph of article 11.

Art. 10. A vessel which is being overtaken by another shall show from her stern to such last-mentioned vessel a white light or a flare-up light.

The white light required to be shown by this article may be fixed and carried in a lantern, but in such case the lantern shall be so constructed, fitted, and screened that it shall throw an unbroken light over an arc of the horizon of twelve points of the compass, namely, for six points from right aft on each side of the vessel, so as to be visible at a distance of at least one mile. Such light shall be carried as nearly as practicable on the same level as the side lights.

Art. 11. A vessel under one hundred and fifty feet in length when at anchor shall carry forward, where it can best be seen, but at a height not exceeding twenty feet above the hull, a white light, in a lantern so constructed as to show a clear, uniform, and unbroken light visible all around the horizon at a distance of at least one mile.

A vessel of one hundred and fifty feet or upwards in length when at anchor shall carry in the forward part of the vessel, at a height of not less than twenty and not exceeding forty feet above the hull, one such light, and at or near the stern of the vessel, and at such a height that it shall not be less than fifteen feet lower than the forward light, another such light.

The length of a vessel shall be deemed to be the length appearing in her certificate of registry.

A vessel aground in or near a fairway shall carry the above light or lights and the two red lights prescribed by article 4 (a).

Art. 12. Every vessel may, if necessary, in order to attract attention in addition to the lights which she is by these rules required to carry, show a flare-up light or use any detonating signal that cannot be mistaken for a distress signal.

Art. 13. Nothing in these rules shall interfere with the operation of any special rules made by the government of any nation with respect to additional station and signal lights for two or more ships of war or for vessels sailing under convoy, or with the exhibition of recognition signals adopted by ship-owners, which have been authorized by their respective governments and duly registered and published.

Art. 14. A steam vessel proceeding under sail only, but having her funnel up, shall carry in daytime, forward, where it can best be seen, one black ball or shape two feet in diameter.

SOUND SIGNALS FOR FOG, AND SO FORTH

Art. 15. All signals prescribed by this article for vessels under way shall be given.

First. By "steam vessels" on the whistle or siren.

Second. By "sailing vessels" and "vessels towed" on the foghorn.

The words "prolonged blast" used in this article shall mean a blast of from four to six seconds' duration.

A steam vessel shall be provided with an efficient whistle or siren sounded by steam or by some substitute for steam, so placed that the sound may not be intercepted by any obstruction, and with an efficient foghorn, to be sounded by mechanical means, and also with an efficient bell. In all cases when the rules require a bell to be used a drum may be substituted on board Turkish vessels, or a gong where such articles are used on board small seagoing vessels. A sailing vessel of twenty tons gross tonnage or upward shall be provided with a similar foghorn and bell.

In a fog, mist, falling snow, or heavy rainstorms, whether by day or night, the signals described in this article shall be used as follows, namely:

(a) A steam vessel having way upon her shall sound, at intervals of not more than two minutes, a prolonged blast.

(b) A steam vessel under way, but stopped, and having no way upon her, shall sound, at intervals of not more than two minutes, two prolonged blasts, with an interval of about one second between.

(c) A sailing vessel under way shall sound at intervals of not more than one minute, when on the starboard tack, one blast; when on the port tack, two blasts in succession; and when with the wind abaft the beam, three blasts in succession.

(d) A vessel when at anchor shall, at intervals of not more than one minute, ring the bell rapidly for about five seconds.

(e) A vessel when towing, a vessel employed in laying or in picking up a telegraph cable, and a vessel under way, which is unable to get out of the

way of an approaching vessel through being not under command, or unable to maneuver as required by the rules, shall, instead of the signals prescribed in subdivisions (a) and (c) of this article, at intervals of not more than two minutes, sound three blasts in succession, namely: One prolonged blast followed by two short blasts. A vessel towed may give this signal and she shall not give any other.

Sailing vessels and boats of less than twenty tons gross tonnage shall not be obliged to give the above-mentioned signals, but if they do not they shall make some other efficient sound signal at intervals of not more than one minute.

SPEED OF SHIPS TO BE MODERATE IN FOG, AND SO FORTH

Art. 16. Every vessel shall, in a fog, mist, falling snow, or heavy rainstorms, go at a moderate speed, having careful regard to the existing circumstances and conditions.

A steam vessel hearing, apparently forward of her beam, the fog signal of a vessel the position of which is not ascertained shall, so far as the circumstances of the case admit, stop her engines, and then navigate with caution until danger of collision is over.

STEERING AND SAILING RULES

PRELIMINARY—RISK OF COLLISION

Risk of collision can, when circumstances permit, be ascertained by carefully watching the compass bearing of an approaching vessel. If the bearing does not appreciably change, such risk should be deemed to exist.

Art. 17. When two sailing vessels are approaching one another, so as to involve risk of collision, one of them shall keep out of the way of the other, as follows, namely:

(a) A vessel which is running free shall keep out of the way of a vessel which is close-hauled.

(b) A vessel which is close-hauled on the port tack shall keep out of the way of a vessel which is close-hauled on the starboard tack.

(c) When both are running free, with the wind on different sides, the vessel which has the wind on the port side shall keep out of the way of the other.

(d) When both are running free, with the wind on the same side, the vessel which is to the windward shall keep out of the way of the vessel which is to the leeward.

(e) A vessel which has the wind aft shall keep out of the way of the other vessel.

Art. 18. When two steam vessels are meeting end on, or nearly end on, so as to involve risk of collision, each shall alter her course to starboard, so that each may pass on the port side of the other.

This article only applies to cases where vessels are meeting end on, or nearly end on, in such a manner as to involve risk of collision, and does not apply to two vessels which must, if both keep on their respective courses, pass clear of each other.

The only cases to which it does apply are when each of the two vessels is end on, or nearly end on, to the other; in other words, to cases in which, by day, each vessel sees the masts of the other in a line, or nearly in a line, with her own; and by night, to cases in which each vessel is in such a position as to see both the side lights of the other.

It does not apply by day to cases in which a vessel sees another ahead crossing her own course; or by night, to cases where the red light of one vessel is opposed to the red light of the other, or where the green light of one vessel is opposed to the green light of the other, or where a red light without a green light, or a green light without a red light, is seen ahead, or where both green and red lights are seen anywhere but ahead.

Art. 19. When two steam vessels are crossing, so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way of the other.

Art. 20. When a steam vessel and a sailing vessel are proceeding in such directions as to involve risk of collision, the steam vessel shall keep out of the way of the sailing vessel.

Art. 21. Where, by any of these rules, one of two vessels is to keep out of the way, the other shall keep her course and speed.

NOTE.—When, in consequence of thick weather or other causes, such vessel finds herself so close that collision cannot be avoided by the action of the giving-way vessel alone, she also shall take such action as will best aid to avert collision. (See articles 27 and 29.)

Art. 22. Every vessel which is directed by these rules to keep out of the way of another vessel shall, if the circumstances of the case admit, avoid crossing ahead of the other.

Art. 23. Every steam vessel which is directed by these rules to keep out of the way of another vessel shall, on approaching her, if necessary, slacken her speed or stop or reverse.

Art. 24. Notwithstanding anything contained in these rules, every vessel overtaking any other shall keep out of the way of the overtaken vessel.

Every vessel coming up with another vessel from any direction more than two points abaft her beam—that is, in such a position, with reference to the vessel which she is overtaking that at night she would be unable to see either of the vessel's side lights—shall be deemed to be an overtaking vessel; and no subsequent alteration of the bearing between the two vessels shall make the overtaking vessel a crossing vessel within the meaning of these rules, or relieve her of the duty of keeping clear of the overtaken vessel until she is finally past and clear.

As by day the overtaking vessel cannot always know with certainty whether she is forward of or abaft this direction from the other vessel she should, if in doubt, assume that she is an overtaking vessel and keep out of the way.

Art. 25. In narrow channels every steam vessel shall, when it is safe and practicable, keep to that side of the fairway or mid-channel which lies on the starboard side of such vessel.

Art. 26. Sailing vessels under way shall keep out of the way of sailing vessels or boats fishing with nets, or lines, or trawls. This rule shall not give to any vessel or boat engaged in fishing the right of obstructing a fairway used by vessels other than fishing vessels or boats.

Art. 27. In obeying and construing these rules, due regard shall be had to all dangers of navigation and collision, and to any special circumstances which may render a departure from the above rules necessary in order to avoid immediate danger.

SOUND SIGNALS FOR VESSELS IN SIGHT OF ONE ANOTHER

Art. 28. The words "short blast" used in this article shall mean a blast of about one second's duration.

When vessels are in sight of one another, a steam vessel under way, in taking any course authorized or required by these rules, shall indicate that course by the following signals on her whistle or siren, namely:

One short blast to mean, "I am directing my course to starboard."

Two short blasts to mean, "I am directing my course to port."

Three short blasts to mean, "My engines are going at full speed astern."

NO VESSEL UNDER ANY CIRCUMSTANCES TO NEGLECT PROPER PRECAUTIONS

Art. 29. Nothing in these rules shall exonerate any vessel, or the owner, or master, or crew thereof, from the consequences of any neglect to carry lights or signals, or of any neglect to keep a proper lookout, or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

RESERVATION OF RULES FOR HARBORS AND INLAND NAVIGATION

Art. 30. Nothing in these rules shall interfere with the operation of a special rule, duly made by local authority, relative to the navigation of any harbor, river, or inland waters.

DISTRESS SIGNALS

Art. 31. When a vessel is in distress and requires assistance from other vessels or from the shore the following shall be the signals to be used or displayed by her, either together or separately, namely:

In the daytime: First. A gun or other explosive signal fired at intervals of about a minute.

Second. The international code signal of distress indicated by N C.

Third. The distance signal, consisting of a square flag, having either above or below it a ball or anything resembling a ball.

Fourth. A continuous sounding with any fog-signal apparatus.

At night: First. A gun or other explosive signal fired at intervals of about a minute.

Second. Flames on the vessel (as from a burning tar barrel, oil barrel, and so forth).

Third. Rockets or shells throwing stars of any color or description, fired one at a time, at short intervals.

Fourth. A continuous sounding with any fog-signal apparatus.

RULES FOR LIGHTS AND DAY SIGNALS TO BE CARRIED BY VESSELS, DREDGES OF ALL TYPES, AND VESSELS WORKING ON WRECKS OR OTHER OBSTRUCTIONS TO NAVIGATION, OR MOORED FOR SUBMARINE OPERATIONS OR MADE FAST TO A SUNKEN OBJECT WHICH MAY DRIFT WITH THE TIDE OR BE TOWED

RULE FOR SIGNALS TO BE DISPLAYED BY A TOWING VESSEL WHEN TOWING A SUBMERGED OR PARTLY SUBMERGED OBJECT UPON A HAWSER WHEN NO SIGNALS ARE DISPLAYED UPON THE OBJECT WHICH IS TOWED

The vessel having the submerged object in tow shall display by day, where they can best be seen, two shapes, one above the other, not less than 6 feet apart, the lower shape to be carried not less than 10 feet above the deck houses. The shapes shall be in the form of a double frustum of a cone, base to base, not less than 2 feet in diameter at the center nor less than 8 inches at the ends of the cones, and to be not less than 4 feet lengthwise from end to end, the upper shape to be painted in alternate horizontal stripes of black and white, 8 inches in width, and the lower shape to be painted a solid bright red.

By night this situation shall be indicated by the display of a white light from the bow and stern of each outside vessel or lighter not less than 6 feet above the deck, and in addition thereto there shall be displayed in a position where they may best be seen from all directions two red lights carried in a vertical line not less than 3 feet nor more than 6 feet apart, and not less than 15 feet above the deck.

RULE FOR DREDGES WHICH ARE HELD IN STATIONARY POSITION BY MOORINGS OR SPUDS

Dredges which are held in stationary position by moorings or spuds shall display by day two red balls not less 2 feet in diameter and carried in a vertical line not less than 3 feet nor more than 6 feet apart, and at least 15 feet above the deck house and in such a position where they can best be seen from all directions.

By night the towing vessel shall display the regular side lights, but in lieu of the regular white towing lights shall display four lights in a vertical position not less than 3 feet nor more than 6 feet apart, the upper and lower of such lights to be white, and the two middle lights to be red, all of such lights to be of the same character as is now prescribed for the regular towing lights.

RULE FOR STEAMERS, DERRICK BOATS, LIGHTERS, OR OTHER TYPES OF VESSELS MADE FAST ALONGSIDE A WRECK, OR MOORED OVER A WRECK WHICH IS ON THE BOTTOM OR PARTLY SUBMERGED, OR WHICH MAY BE DRIFTING

Steamers, derrick boats, lighters, or other types of vessels made fast alongside a wreck, or moored over a wreck which is on the bottom or partly submerged, or which may be drifting, shall display by day two shapes of the same character and dimensions and displayed in the same manner as required by the foregoing rule, except that both the shapes shall be painted a solid bright red, but where more than one vessel is working under the above conditions, the shapes need be displayed only from one vessel on each side of the wreck from which it can best be seen from all directions.

By night they shall display a white light at each corner, not less than 6 feet above the deck, and in addition thereto there shall be displayed in a position where they may best be seen from all directions two red lights carried

in a vertical line not less than 3 feet nor more than 6 feet apart, and not less than 15 feet above the deck. When scows are moored alongside a dredge in the foregoing situation they shall display a white light on each outboard corner not less than 6 feet above the deck.

RULE FOR SELF-PROPELLING SUCTION DREDGES UNDER WAY WITH THEIR SUCTIONS ON THE BOTTOM

Self-propelling suction dredges under way with their suctions on the bottom shall display by day the same signals as are used to designate any steamer not under control; that is to say, two black balls not less than 2 feet in diameter and carried not less than 15 feet above the deck house, and where they may best be seen from all directions.

By night they shall carry, in addition to the regular running lights, two red lights of the same character as the masthead light, in the same vertical plane and underneath the masthead light, the red lights to be not less than 3 feet nor more than 6 feet apart and the upper red light to be not less than 4 feet and not more than 6 feet below the white masthead light, and on or near the stern two red lights in the same vertical plane not less than 4 feet nor more than 6 feet apart, to show through 4 points of the compass; that is, from right astern to 2 points on each quarter.

RULE FOR VESSELS WHICH ARE MOORED OR ANCHORED AND ENGAGED IN LAYING PIPE OR OPERATING ON SUBMARINE CONSTRUCTION OR EXCAVATION

Vessels which are moored or anchored and engaged in laying pipe or operating on submarine construction or excavation shall display by day, not less than 15 feet above the deck, where they can best be seen from all directions, two balls not less than 2 feet in diameter, in a vertical line not less than 3 feet and not more than 6 feet apart, the upper ball to be painted in alternate black and white vertical stripes 6 inches wide, and the lower ball to be painted a solid bright red.

By night they shall display three red lights carried in a vertical line not less than 3 feet nor more than 6 feet apart and not less than 15 feet above the deck, and in such position as may best be seen from all directions. All the lights required by these special rules for dredges, wrecking boats, lighters, etc., shall be of such size and character as to be visible on a dark night with a clear atmosphere for a distance of at least 2 miles.

RULE FOR SPEED OF VESSELS PASSING FLOATING PLANT WORKING IN CHANNELS

Steamers with or without tows, passing floating plant working in channels, shall reduce their speed sufficiently to insure the safety of both said plant and themselves, and when passing within 200 feet of said plant their speed shall not exceed 5 miles per hour. While passing over lines of said plant, propelling machinery shall be stopped.

RULE RELATING TO THE USE OF SEARCHLIGHTS

Any master or pilot of any steam vessel who shall flash or cause to be flashed the rays of the searchlight into the pilot house of a passing vessel shall be deemed guilty of misconduct and shall be liable to have his license suspended or revoked.

RULE FOR VESSELS WHICH ARE MOORED OR AT ANCHOR

Vessels of more than 300 gross tons propelled by machinery when moored or anchored in a fairway or channel where traffic is liable to congestion or confusion shall display between sunrise and sunset on the forward part of the vessel where it can best be observed from other vessels one black ball or shape not less than 2 feet in diameter.

RULE PROHIBITING THE CARRYING OF UNAUTHORIZED LIGHTS ON STEAM VESSELS

Any master or pilot of any steam vessel who shall authorize or permit the carrying of any light, electric or otherwise, not required by law, on the outside structure of the cabin or hull of the vessel that in any way will interfere

with distinguishing the signal lights, shall, upon conviction thereof before any board of inspectors having jurisdiction, be deemed guilty of misconduct and shall be liable to have his license suspended or revoked.

RULES FOR MOTOR BOATS

AN ACT To amend laws for preventing collisions of vessels and to regulate equipment of certain motor boats on the navigable waters of the United States

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the words "motor boat" where used in this act shall include every vessel propelled by machinery and not more than sixty-five feet in length, except tug boats and tow boats propelled by steam. The length shall be measured from end to end over the deck, excluding sheer: *Provided,* That the engine, boiler, or other operating machinery shall be subject to inspection by the local inspectors of steam vessels, and to their approval of the design thereof, on all said motor boats, which are more than forty feet in length, and which are propellel by machinery driven by steam.

Sec. 2. That motor boats subject to the provisions of this act shall be divided into classes as follows:

Class one. Less than twenty-six feet in length.

Class two. Twenty-six feet or over and less than forty feet in length.

Class three. Forty feet or over and not more than sixty-five feet in length.

Sec. 3. That every motor boat in all weathers from sunset to sunrise shall carry the following lights, and during such time no other lights which may be mistaken for those prescribed shall be exhibited.

(a) Every motor boat of class one shall carry the following lights:

First. A white light aft to show all around the horizon.

Second. A combined lantern in the fore part of the vessel and lower than the white light aft showing green to starboard and red to port, so fixed as to throw the light from right ahead to two points abaft the beam on their respective sides.

(b) Every motor boat of classes two and three shall carry the following lights:

First. A bright white light in the fore part of the vessel as near the stem as practicable, so constructed as to show an unbroken light over an arc of the horizon of twenty points of the compass, so fixed as to throw the light ten points on each side of the vessel, namely, from right ahead to two points abaft the beam on either side. The glass or lens shall be of not less than the following dimensions:

Class two. Nineteen square inches.

Class three. Thirty-one square inches.

Second. A white light aft to show all around the horizon.

Third. On the starboard side a green light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the starboard side. On the port side a red light so constructed as to show an unbroken light over an arc of the horizon of ten points of the compass, so fixed as to throw the light from right ahead to two points abaft the beam on the port side. The glasses or lenses in the said side lights shall be of not less than the following dimensions on motor boats of—

Class two. Sixteen square inches.

Class three. Twenty-five square inches.

On and after July first, nineteen hundred and eleven, all glasses or lenses prescribed by paragraph (b) of section three shall be fresnel or fluted. The said lights shall be fitted with inboard screens of sufficient height and so set as to prevent these lights from being seen across the bow and shall be of not less than the following dimensions on motor boats of—

Class two. Eighteen inches long.

Class three. Twenty-four inches long: *Provided,* That motor boats as defined in this act, when propelled by sail and machinery or under sail alone, shall carry the colored lights suitably screened but not the white lights prescribed by this section.

Sec. 4. (a) Every motor boat under the provisions of this act shall be provided with a whistle or other sound-producing mechanical appliance capable of producing a blast of two seconds or more in duration, and in the case of

such boats so provided a blast of at least two seconds shall be deemed a prolonged blast within the meaning of the law.

(b) Every motor boat of class two or three shall carry an efficient foghorn.

(c) Every motor boat of class two or three shall be provided with an efficient bell, which shall be not less than eight inches across the mouth on board of vessels of class three.

Sec. 5. That every motor boat subject to any of the provisions of this act, and also all vessels propelled by machinery other than by steam more than sixty-five feet in length, shall carry either life preservers or life belts or buoyant cushions, or ring buoys or other device, to be prescribed by the Secretary of Commerce, sufficient to sustain afloat every person on board and so placed as to be readily accessible. All motor boats carrying passengers for hire shall carry one life preserver of the sort prescribed by the regulations of the Board of Supervising Inspectors for every passenger carried, and no such boat while so carrying passengers for hire shall be operated or navigated except in charge of a person duly licensed for such service by the local board of inspectors. No examination shall be required as the condition of obtaining such a license, and any such license shall be revoked or suspended by the local board of inspectors for misconduct, gross negligence, recklessness in navigation, intemperance, or violation of law on the part of the holder, and if revoked the person holding such license shall be incapable of obtaining another such license for one year from the date of revocation: *Provided*, That motor boats shall not be required to carry licensed officers, except as required in this act.

Sec. 6. That every motor boat and also every vessel propelled by machinery other than by steam, more than sixty-five feet in length, shall carry ready for immediate use the means of promptly and effectually extinguishing burning gasoline.

Sec. 7. That a fine of not exceeding one hundred dollars may be imposed for any violation of this act. The motor boat shall be liable for the said penalty and may be seized and proceeded against, by way of libel, in the district court of the United States for any district within which such vessel may be found.

Sec. 8. That the Secretary of Commerce shall make such regulations as may be necessary to secure the proper execution of this act by collectors of customs and other officers of the Government. And the Secretary of the Department of Commerce may, upon application therefor, remit or mitigate any fine, penalty, or forfeiture relating to motor boats except for failure to observe the provisions of section six of this act.

Sec. 9. That all laws and parts of laws only insofar as they are in conflict herewith are hereby repealed: *Provided*, That nothing in this act shall be deemed to alter or amend acts of Congress embodying or revising international rules for preventing collisions at sea.

BOUNDARY LINES OF THE HIGH SEAS

The following lines divide the high seas from rivers, harbors, and inland waters. Waters inshore of the lines here laid down are "*inland waters*", and upon them the inland rules and pilot rules for inland waters apply. Upon the high seas, viz, waters outside the lines here laid down, the international rules apply.

(All bearings are in degrees true; distances in nautical miles and are given approximately)

San Diego Harbor.—A line from the southerly tower of the Coronado Hotel 224½°, 4⅞ miles, to San Diego Bay entrance lighted whistle buoy 1A; thence 3½°, 2⅝ miles, to Point Loma Lighthouse.

San Francisco Harbor.—A line drawn through Mile Rocks Lighthouse 326° to Bonita Point Lighthouse.

Columbia River Entrance.—A line drawn from Knuckle of Columbia River south jetty 351° to Cape Disappointment Lighthouse.

General rule.—At all buoyed entrances from seaward to bays, sounds, rivers, or other estuaries for which specific lines have not been described, inland rules shall apply inshore of a line approximately parallel with the general trend of the shore, drawn through the outermost buoy or other aid to navigation of any system of aids.

EXTRACTS FROM THE RULES AND REGULATIONS OF THE BOARD OF HARBOR COMMISSIONERS OF THE TERRITORY OF HAWAII

RULE III.—HARBOR MASTER—JURISDICTION, POWERS, AND DUTIES

(*a*) The harbor master shall have, at the port for which he is appointed, exclusive charge and control, except as otherwise provided by law, of all ocean shores below high-water mark, shore waters and navigable streams which are now, or may be, under the care and control of the board; and he shall have also, at such ports, exclusive charge and control of all wharves, piers, bulkheads, quays or landings, and structures thereon, and waters adjacent thereto, and of all slips, basins, docks, water-front land under water, and structures thereon, and the appurtenances, easements, reversions and rights belonging thereto that are now, or may be, the property, or under the control, of the Territory.

(*c*) He shall, so far as possible, require and enforce, or procure the enforcement of the due observance of, and compliance with, all such rules, regulations and orders of the board, or such laws as appertain to the use, care, and custody of the property under the jurisdiction of the board.

(*d*) He shall require masters of all vessels to conform to the rules and regulations of the board.

(*e*) He shall assign berths, and regulate the position of vessels in the harbor.

(*f*) He shall require the wharves and other premises under the jurisdiction of the board to be kept in a clean and sanitary condition and free from all obstructions.

RULE IV.—WHARFINGER—JURISDICTION, POWERS, AND DUTIES

(*a*) The wharfinger shall have exclusive charge and control of all wharves, piers, bulkheads, quays or landings, and structures thereon and waters adjacent thereto, and all slips, basins, docks, water-front land under water and structures thereon and the appurtenances, easements, reversions, and rights belonging thereto, that are now, or may be, the property of, or under the control of the Territory, at the port for which he is appointed.

(*b*) He shall, so far as possible, require and enforce, or procure the enforcement of the due observance of and compliance with all such rules and regulations and orders of the board, and all such laws as appertain to the use, care, and custody of the wharf and wharves and other property under the jurisdiction of the board.

(*c*) He shall require the wharves and other premises under his jurisdiction to be kept in a clean and sanitary condition and free from all obstructions.

(*h*) He shall collect wharfage from any vessel not on the credit wharfage list discharging or receiving freight on or from any wharf, pier, bulkhead, quay or landing, and shall promptly remit the same to the board.

RULE V.—PILOTS—JURISDICTION, POWERS, AND DUTIES

(*g*) The master of any vessel requiring a pilot to conduct his vessel to sea must make application to the harbor master.

(*h*) Every pilot piloting a vessel inward, unless required to anchor at the quarantine station, shall bring the vessel to such pier or berth as the harbor master may direct.

(*j*) No pilot shall, in any case, conduct a vessel to sea until she has been regularly cleared at the custom house and harbor master's office; and no pilot shall take a vessel to sea until he has satisfied himself that she has been so cleared.

(*n*) Any person having any complaint against any pilot is requested to make the same in writing to the board, and all complaints by any pilot shall be made in writing to the harbor master, who shall forthwith forward same to the board.

(*o*) All pilots appointed by the board shall observe strictly the regulations relative to pilotage fees at the ports of Honolulu, Hilo, and Kahului, which are as follows:

Pilotage fees at the Ports of Honolulu, Hilo, and Kahului.—1. Subject to the navigation laws of the United States, the following fees shall be paid to the Board of Harbor Commissioners by all steamers for the service of pilots at

the ports of Honolulu, Hilo, and Kahului for entering and also for departing from each such port:

999 tons displacement, or under	$10.00
1,000 to 1,499 tons displacement, inclusive	15.00
1,500 to 1,999 tons displacement, inclusive	20.00
2,000 to 2,999 tons displacement, inclusive	25.00
3,000 to 3,999 tons displacement, inclusive	30.00
4,000 to 4,999 tons displacement, inclusive	35.00
5,000 to 5,999 tons displacement, inclusive	40.00
6,000 to 7,999 tons displacement, inclusive	45.00
8,000 to 9,999 tons displacement, inclusive	47.50
10,000 to 11,999 tons displacement, inclusive	50.00
12,000 to 14,999 tons displacement, inclusive	52.50
15,000 to 17,999 tons displacement, inclusive	55.00
18,000 to 20,999 tons displacement, inclusive	57.50
21,000 to 23,999 tons displacement, inclusive	60.00
24,000 to 26,999 tons displacement, inclusive	62.50
27,000 to 29,999 tons displacement, inclusive	65.00
30,000 to 32,999 tons displacement, inclusive	67.50
33,000 tons displacement, or over	70.00

Provided, That if for the purpose of loading or discharging cargo any steamer enters and departs from two of the said above-named ports in charge of a pilot, on one continuous trip, 5 percent shall be deducted from the above schedule of fees: *Provided further*, That if for the purpose of loading or discharging cargo any steamer enters and departs from three of the above-named ports in charge of a pilot during one continuous trip, 15 percent shall be deducted from the foregoing schedule of fees; and for the purpose of computing said fees one call at any of the above-named ports and two calls at any one of the other ports shall be considered as calling at three ports.

II. All sail vessels shall pay fees for pilot services at such ports, amounting to 2 cents per gross ton upon the registered tonnage of such vessel, for entering and also for departing, from each such port, the minimum charge each way to be $25.

III. Subject to the restrictions aforesaid, any vessel which shall enter or depart from any of the above-named ports without a pilot shall pay one-half pilotage fees.

IV. All vessels of 3,000 tons displacement, or over, touching at the above-mentioned ports solely for the purpose of securing general supplies shall pay for pilot services a fee of $25 for entering and $25 for departing from such ports.

V. Where not otherwise provided, the fee for pilot service shall be $1 per foot on the vessel's draft for entering port and the same for departing: *Provided, however*, That the board reserves the right to rebate all pilot charges to all war vessels.

VI. When any vessel is forced to enter or reenter any of the above-mentioned ports solely by reason of stress of weather, the Board of Harbor Commissioners may require the payment of only such fees for pilot service as shall be just and equitable under the circumstances.

VII. For anchoring any vessel off the above-mentioned ports the fee shall be $20: *Provided, however*, That when any vessel so anchored off any such port is later brought into port under the charge of a pilot, the fee for anchoring off port shall be $10.

VIII. For retention of pilot on board a vessel more than 24 hours, the fee shall be $10 per day, or fraction thereof. And, if owing to unavoidable circumstances, said pilot has been carried to another port, the vessel, or owner thereof, shall further pay the traveling expenses of said pilot in returning, by first class passage, to his former port.

IX. The displacement of each steamer shall be computed in accordance with the Builder's Displacement Scale, and for this purpose said scale shall be divided into fractional parts of a foot, equalling 3 inches. In case a satisfactory displacement scale is not furnished by the vessel or her authorized agents, her displacement shall be computed by the method known as "Simpson's Rules," using the coefficient of 0.7; e. g., length times breadth times draft times 0.7 divided by 85. (Shorter formula is as follows: Length times breadth times draft times 0.02.)

RULE VIII.—MOORING OR ANCHORAGE BUOYS

(a) All private individuals, corporations, or companies desiring to install mooring or anchorage buoys in any waters, bays, harbors, rivers, or creeks, under the jurisdiction of the board, shall make formal application to the board in writing for permission to install such buoys. This application shall be

accompanied by a comprehensive plan, showing the exact proposed location of the buoys, also plans and specifications of the type and size of buoy.

(*b*) No buoy which resembles any Federal aid to navigation shall be allowed in any of the harbors or other waters under control of the board.

(*c*) The right will be reserved by the board to revoke any license at any time when, in its opinion, such revocation may be necessary.

RULE IX.—MOORING OF BOATS, SCOWS, ETC., TO GOVERNMENT WHARVES

(*a*) No person or persons shall cause or permit any boat, scow, punt, raft, log, or other floating article to come alongside, or to be moored to or near, or made fast to or near any wharf, pier, bulkhead, quay, or landing belonging to, or controlled by, the Territory of Hawaii, in any manner that may cause damage to such wharf, pier, bulkhead, quay, or landing.

(*b*) It shall be the duty of the harbor master to take immediate possession of any boat, scow, punt, raft, log, or other floating article which has been left by its owner or custodian alongside, or near any wharf, pier, bulkhead, quay, or landing belonging to, or controlled by, the Territory of Hawaii, in such a position that it might cause damage to such wharf, pier, bulkhead, quay, or landing, and to remove the same to some suitable place. The owner thereof, if known, shall be forthwith notified in writing by the harbor master of such taking. If the owner thereof is unknown, due notice of such taking shall be given by posting the same upon the bulletin board at the office of the Board of Harbor Commissioners. After the expiration of a period of 10 days from the date of the giving of such notice, as aforesaid, if no claim is made for such property the harbor master may sell or otherwise dispose thereof, and the proceeds of such sale shall become a Government realization.

RULE X.—WHARFAGE

(*a*) All such water craft as shall discharge or receive freight, stores, supplies, fuel, oil, ballast, passengers, or baggage on or from any wharf, pier, bulkhead, quay, or landing belonging to or controlled by the Territory, while made fast to or lying alongside of the same, shall pay to the Board of Harbor Commissioners, as wharfage, the sum of four (4) cents per ton per diem on the net registered tonnage of the vessel, except as otherwise provided in rule 10, (*b*). All agents or masters of vessels must on arrival of said vessel deliver the ships' official register to the harbor master's office, for the purpose of verifying the net and gross tonnage and the dimensions of the vessel.

(*b*) All water craft while lying idle and while made fast to, or lying alongside of any wharf, pier, bulkhead, quay, or landing belonging to or controlled by the Territory, shall pay to the board, as wharfage, the sum of four (4) cents per ton per diem on the net registered tonnage of the vessel: *Provided*, That all vessels which are engaged exclusively in towing shall pay the sum of two (2) cents per diem, per ton, on the net registered tonnage: *Provided further*, That all water craft lying idle, outside of other water craft lying at a wharf, and all water craft undergoing repairs, shall pay the sum of two (2) cents per ton per diem on the net registered tonnage.

No reduction in rates will be made for any part or parts of idle days during the period of discharging or receiving of freight, stores, supplies, fuel, fuel oil, ballast, passengers, or baggage.

There shall be no charge for Sundays and legal holidays, except for water craft discharging or receiving freight, stores, supplies, fuel, fuel oil, ballast, passengers, or baggage, in which case they shall pay full rates.

A full day's wharfage shall be from midnight to midnight, and a half-day's wharfage from midnight to noon, or from noon to midnight, and wharfage charges shall be made accordingly:

(*c*) All such water craft as shall receive or discharge freight, stores, supplies, fuel, oil, molasses, ballast, passengers, or baggage, (first) from or upon any wharf, pier, bulkhead, quay, or landing belonging to or controlled by the Territory, by means of boats, lighters, or otherwise, while lying at anchor, or under steam, in any bay, harbor, or roadstead, whether such boats or lighters are loaded from or unloaded onto such wharf during, before, or after the time while such water craft is at anchor or under steam as aforesaid, provided such loading or unloading is of the freight, supplies, stores, fuel, oil, molasses, ballast, passengers, or baggage of such water craft and as a part of the trip of

such water craft or (second) while lying in any slip or dock belonging to or controlled by the Territory, but not made fast to or lying alongside of any wharf, pier, bulkhead, quay, or landing, shall pay to the Board of Harbor Commissioners as wharfage the sum of two (2) cents per ton per diem on the net registered tonnage of the vessel except as otherwise provided for in (*d*) of rule 10.

(*d*) Any water craft discharging or receiving freight by means of boats, lighters, rafts, or otherwise that are made fast to, or lying alongside any wharf, pier, quay, bulkhead, or landing belonging to or controlled by the Territory, while lying at anchor or under steam in any bay, harbor, or roadstead or while lying in any slip or dock belonging to or controlled by the Territory, but not made fast to or lying alongside of any wharf, pier, bulkhead, quay, or landing, shall pay to the Board of Harbor Commissioners on the net registered tonnage of the vessel as per the following schedule:

6 hours or less	$0.005
Over 6 hours and less than 12 hours	.01
12 hours or more and less than 18 hours	.015
18 hours or more and less than 24 hours	.02

Provided, however, That if any such water craft during a trip shall so use only one wharf, pier, quay, bulkhead, or landing during a day of twenty-four (24) hours and for a less period than twelve (12) hours, the charge therefor shall be $0.01 per ton, and

Provided further, That if any such water craft during a trip, shall so use only one wharf, pier, quay, bulkhead, or landing, during a day of twenty-four (24) hours, and for a period of twelve (12) hours or more, the charge therefor shall be $0.02 per ton.

(*e*) Any wharf, pier, quay, or landing belonging to or controlled by the Territory shall be considered as in continuous use for the purpose of these rules and regulations, by any vessel lying at anchor or under steam, in any bay, harbor, or roadstead, from the time of arrival at any such wharf, pier, bulkhead, quay, or landing of any boat, lighter, or raft from said vessel and the actual receiving or discharging of freight or passengers on or from said wharf, pier, bulkhead, quay, or landing, until the final departure of the last boat or lighter from said wharf, pier, bulkhead, quay, or landing for said vessel.

Provided, however, That if any such vessel while anchored is compelled by stress of weather to discontinue loading (and) or unloading temporarily, such time of discontinuance shall not be included in the time for which the above wharfage rates are charged, and

Provided further, That in case any sailing vessel so anchored has completed loading (and) or unloading and has cleared for another port and being otherwise ready to sail, is detained at anchor awaiting favorable winds or a tow, no charge shall be made for such period of detention.

(*f*) The board may, in its discretion, release parties from the obligation of paying wharfage on vessels in the manner required by these rules provided such parties make written application to be placed on the credit wharfage list. Such application shall give the names and classes of vessels of which they are the owners, managers, agents, or consignees and shall agree to pay on presentation, until written notice to the contrary, wharfage bills on all such vessels. In case of failure to pay such bill on presentation, the permission granting release as aforesaid shall be revoked.

(*g*) All tenders, tugs, or other water craft lying alongside of or tied up to any vessel made fast to or lying alongside of any wharf, pier, bulkhead, quay, or landing belonging to or controlled by the Territory, and delivering freight to or receiving freight from such moored vessels, shall pay, as wharfage, the sum of 2 cents per ton per diem on the net registered tonnage of said tenders, tugs, or other water craft.

RULE XI.—DEMURRAGE

(*a*) An all wharves at the ports of Honolulu and Hilo freight direct from foreign ports must be removed from the wharf beginning at midnight after a general order has been issued by the collector of customs, as follows: (1) Cargoes of less than 2,500 tons, 48 hours; (2) cargoes of over 2,500 tons, 72 hours: *Provided*, That the above rules shall not apply to freight for transshipment when such transshipment is designated in original bills of lading and on packages: *Provided further*, That freight for transshipment must be removed not later than the time of sailing of the first vessel whose destination is the

port for which the freight is intended in accordance with the route as per the bill of lading.

(*b*) All freight other than that direct from foreign ports must be removed as follows, except as otherwise provided in paragraph (*c*): Cargoes up to and including 2,000 tons delivered to any one wharf within 48 hours after completion of discharge of vessel: for each additional 1,000 tons or fraction thereof an additional 24 hours will be allowed.

(*c*) All outgoing freight shall be entitled to free storage on the wharf beginning three days prior to the commencement of loading of vessels: *Provided, however*, That demurrage will be waived on freight from United States ports, other than in the Hawaiian Islands, destined for transshipment, up to the time of sailing on the first vessel in accordance with the route as per bill of lading and whose destination or port of call is the port for which the freight is intended.

(*d*) A demurrage of 25 cents per ton of 2,000 pounds, or 40 cubic feet, will be made per diem, or fractional part thereof, on all freight remaining on any wharf at the ports of Honolulu and Hilo not in accordance with these rules.

(*e*) No freight subject to demurrage shall be removed from the wharf by the consignee, or any other person, until all charges thereon have been paid and a written release given by the harbor master.

RULE XIII.—SHIPS

(*a*) A master or person in charge of any vessel, and the master of any tug having a vessel in tow, shall obey and carry into effect any orders given by the harbor master in relation to the plans and manner of bringing vessels to an anchorage, coming alongside, or leaving wharves before securing or mooring vessels.

(*b*) The master of every vessel shall anchor, moor, or place his vessel where the harbor master may direct, and shall not move, nor allow the said vessel to be moved, from such place without permission of the harbor master, and shall remove his vessel from any such place when so ordered by the harbor master: *Provided*, That vessels engaged in island or interisland traffic may be exempt from this regulation at the discretion of the harbor master.

(*c*) Preference berthing privileges to vessels making regular calls will be considered upon written application to the board.

(*d*) No vessel shall anchor in the fairway of any channel so as to obstruct the approach of any wharf, pier, bulkhead, quay, or landing.

(*e*) Speed of vessels.—1. All steamships of over 1,000 tons net registered tonnage, and towboats with a tow, when entering and leaving the port of Honolulu, and inside the outer channel buoy, shall proceed (except in case of emergency) at a rate of speed not to exceed 5 miles per hour.

2. All steamships of less than 1,000 tons net registered tonnage, when entering and leaving the port of Honolulu, and inside the no. 3 channel beacon, shall proceed (except in case of emergency) at a rate of speed not to exceed 5 miles per hour.

3. All sampans, gasoline launches, steam launches, and motorboats, when navigating in the waters of Honolulu Harbor and inside the no. 5 channel buoy, shall proceed (except in case of emergency) at a rate of speed not to exceed 10 miles per hour.

(*f*) Trying of engines.—1. Any steamship lying at a wharf in Honolulu or Hilo Harbor wishing to try her engines must first notify any vessel in the near vicinity that she is going to do so; and the speed of such engines while being tried shall not exceed the speed such engines would make under a slow bell.

2. Any steamship lying at a wharf in Honolulu or Hilo Harbor, while trying her engines, must have a responsible person stationed in such a position that he can see any vessel that would be likely to cross the wake of his vessel, and on seeing such vessel his engines must be stopped immediately.

3. Any steamship while lying at a wharf in Honolulu or Hilo Harbor, will be held responsible for any damage done to the wharf or to other vessels caused by the vessel trying her engines.

(*h*) The master of every vessel moored or anchored within the harbors of Honolulu, Hilo, Kahului, and Port Allen shall have both cables clear and in readiness to slack away when required.

(*i*) The master of every vessel and crew thereof, when requested by the harbor master, shall give and afford to the harbor master all possible aid and

assistance in the performance of any of the duties of the harbor master in relation to such vessel.

(*j*) In case any person shall fail to observe any of these rules and regulations, or if by reason of there being no person having authority on board of any ship, or by reason of there not being a sufficient number of persons on board of any ship there should be any noncompliance with any of these rules, or if the master or crew of any vessel refuse to aid and assist the harbor master in moving, mooring, or unmooring such vessel, the harbor master is hereby empowered to moor or unmoor, place, or remove such vessel, and for that purpose may direct the casting off or loosening of any warp or rope, or unshackling or loosening any chain by which a ship is moored or fastened, and may hire such assistance and tackle, and may purchase and put on board such vessel such quantity of ballast as to him seems requisite, at the cost and charge of the master or owner of such vessel; and such cost and charge shall be due and payable to the board before a permit for the departure of such vessel shall be given; and the board shall in no way be liable for any damages or loss occurring to any vessel during or in consequence of such mooring, unmooring, or placing of any such vessel.

(*k*) No person, without the consent or authority of the harbor master, shall cut or cast off any rope or tackle made fast or attached to any vessel, wharf, mooring, buoy, or other place where the same has been fastened or attached by the harbor master, or by his order or direction.

(*l*) No person shall make fast any rope or mooring to any wharf, pier, bulkhead, quay, or landing (except to the mooring piles, mooring bitts, or rings provided for that purpose), or to any shed or piles supporting same, or to any dolphins or fender piles.

(*n*) The master of every vessel shall provide the necessary tackle for the proper slinging of all goods discharged from his vessel onto any wharf, or loaded, or intended to be loaded, from any wharf into his vessel and shall pay for any damage that may be done to the wharf or other property under the control of the Board, either from the breakage of the slings, or from the goods being imperfectly slung, or by the landing or shipping of such goods.

(*o*) The master of every vessel lying alongside of any wharf shall fix, and at all times keep fixed, a safe and proper gangway from such vessel to the wharf.

(*p*) All vessels lying alongside any wharf shall display, between sunset and sunrise, a light pointing toward the harbor.

(*q*) All dirt or rubbish on any wharf or landing occasioned by, or due to, the loading or unloading of any vessel, shall be thoroughly cleared from the wharf that has been used by such vessel, at the expense of the master or owner thereof. The estimate of the cost of such clearing shall be made by the harbor master or wharfinger, and no permit for the departure of said vessel shall be issued until such sum is paid or the payment thereof provided for.

(*r*) All vessels are prohibited from pumping bilge or discharging any waste, oil, or fuel oil into the waters of any harbor of the Territory of Hawaii.

(*s*) Oil carriers, schooners, owners, or users of pipe lines, and all persons are prohibited from discharging oil directly or indirectly into the waters of any harbor of the Territory of Hawaii.

(*t*) The master of any vessel berthed at any pier, before beginning to discharge or load such vessel, shall obtain permission in writing from the harbor master or wharfinger for such discharge or loading; and such discharge or loading shall be continued until completed, by working at such hours as the harbor master or wharfinger may direct: *Provided*, That such direction shall not be in contravention with any law or regulation of the Federal or Territorial authorities.

(*u*) No person shall make any watercraft fast to any steps or landing place for passengers or freight, or allow it to be so near thereto as to obstruct the approach of other watercraft, or allow any watercraft to lie longer along such steps or landing place than shall be required for landing or embarking passengers or freight.

RULE XIV.—FIRE PREVENTION—EXPLOSIVES, COMBUSTIBLES, PAINTS, OILS, AND ACIDS

(*a*) No gunpowder or other explosive shall be discharged on or loaded from any wharf, structure, or vessel at any harbor under the control of the board except by permission of the harbor master, and any such explosive so discharged, with such permission shall be removed immediately.

(*b*) No explosive shall be discharged or loaded from any wharf or structure or vessel at any harbor under the control of the board except in net slings provided by the vessel. the mesh of such slings not to be larger than 5 inches; and no explosive shall be received unless in sound containers.

(*c*) No gasoline, distillate, kerosene, benzine, naphtha, turpentine, nor other goods of a dangerous and inflammable character shall be landed on any wharf, except between the hours of 7 a.m. and 3:30 p.m.; and such articles must be removed from the wharf by 4:30 p.m. of the same day; and if any such articles should be landed in a leaky container, the same shall be immediately removed.

(*d*) No empty containers that have been used to hold gasoline, distillate, benzine, or any other article of a similar inflammable nature shall be delivered onto any wharf or structure under the control of the board unless the same are securely plugged with metal screw plugs, and such containers shall be delivered on any wharf only at such times as the vessel is, or its boats are, prepared to take immediate delivery of the same.

(*e*) No nitrate of soda, sulphur, or other similar material shall be stored, awaiting transportation. upon any wharf within the Territory of Hawaii unless the same be packed in sound and nonleaky containers. All nitrate of soda, sulphur, or other similar material so stored shall be under the continuous care of a competent watchman until removed, the expense of such watchman to be paid by the consignee or consignor.

(*f*) Master, owners, and consignees of nitrate of soda cargoes, sulphur, or other similar materials must keep the wharf at all times swept clean and free of any loose nitrate of soda, sulphur, or other similar materials during the entire process of unloading and removing cargo. No loose nitrate of soda, sulphur, or other similar materials will be permitted to be landed on any wharf. In all cases nitrate of soda, sulphur, and other similar materials must be in sound containers when landed from ships.

(*g*) During the process of discharging or removing cargoes of nitrate of soda, sulphur, (and) or similar materials it shall be obligatory on the part of the master, owner, or agents of the vessel from which such cargo is being unloaded to provide water containers of not less than 50 gallons each, at intervals of not less than 50 feet apart, with suitable buckets placed alongside each container; said containers to be filled with a solution of water and nitrate of soda to be used in case of fire.

(*h*) All acids of a dangerous character shall be removed from the wharf immediately after being landed.

(*i*) All paints or oils in leaky containers shall be removed from the wharf immediately after being landed.

(*j*) All empty containers that have been used for transporting gasoline, distillate, or any material of similar inflammable nature must be removed from the wharf immediately after being landed.

(*k*) All persons are prohibited from delivering any goods specified or referred to in XIV *b* or XIV *i* on any wharf until the vessel is ready to receive such goods on board; and all persons are prohibited from delivering any of the articles specified or referred to in XIV *c*, XIV *h*, and XIV *i* onto any wharf in leaky containers.

(*l*) No combustible materials, such as pitch, tar, resin, or oil, shall be heated on board any vessel within the harbors or streams of the Territory of Hawaii without permission of the harbor master.

(*m*) No vessel shall be fumigated or smoked at any wharf without permission in writing from the harbor master or wharfinger.

(*n*) All steam appliances when used upon any wharf, or upon any scow or pile driver, or other vessel when working alongside or near any wharf shall be equipped with spark arresters to the satisfaction of the harbor master or wharfinger, and at the close of each day's work all ashes, coal, cinders, waste, or other deposit caused by such appliances shall be cleared up and removed from such wharf.

(*o*) No person shall make, repair, dress, or scrape a spar or mast, or do any kind of work on any wharf in connection with the repairing or fitting-out of any boat or vessel, without written permission of the harbor master or wharfinger.

(*p*) All smoking is prohibited on or in any wharf or shed or other structure under the control of the board, and all persons are prohibited from entering into, standing in or on or under or passing through, with a lighted pipe, cigar, or cigarette, any wharf, shed, or other structure under the control of the board.

(*q*) The use of explosives on or in any wharf or shed or other structure under the control of this board, or in the vicinity of same or in any water in the immediate vicinity of wharves under control of the board, is strictly prohibited.

RULE XVII.—STORAGE ON WHARVES

(*a*) Application for rental of storage space by owners or agents of vessels or by common carriers will be considered when presented in writing to the Board.

(*b*) Rates will be furnished upon application.

RULE IX.—CHARGES FOR THE USE OF FUEL-OIL PIPE LINES

(*a*) The charge for the use of the fuel-oil pipe line shall be 2 cents per barrel of oil pumped through the line, whether from ships to tanks or from tanks to ships, or to other users of fuel oil.

(*b*) Firms, corporations, or individuals using the fuel-oil pipe lines must provide the necessary hose to connect the line with the receiving or discharging watercraft.

(*c*) Permits to use the pipe line will be granted to those corporations, firms, or individuals who are in a position to deliver oil to or from vessels berthed at Government wharves at a minimum volume of 1,000 barrels per hour.

(*d*) To regulate delivery of fuel oil to ships berthed at Government wharves, no barge or oil tank, vessel, or other container will be permitted to discharge oil to, or receive oil from, any vessel berthed at a Government wharf in the harbors of Honolulu or Hilo during such time as the fuel-oil pipe line in the respective harbors is in a condition properly to receive from or deliver oil to ships berthed at wharves owned or controlled by the Territory of Hawaii.

(*e*) Damage of any nature to wharf or to merchandise stored thereon caused by leaks from hose, or from carelessness in handling oil hose, will be chargeable to the firm, corporation, or individual using the fuel-oil pipe line at the time the damage was done.

(*f*) Storage of oil hose on the wharves will be granted on application to the harbor master. Any oil hose stored on territorial property will be at the owner's risk, and shall be moved by the owner at any time when ordered by the harbor master.

RULE XXI.—A.—CONTROL OF WATER CRAFT

1. All water craft propelled in whole or in part by steam, gas, gasoline, petroleum, kerosene, naphtha, electricity or sail, shall observe the following regulations in respect to travel in the ocean waters off Waikiki, Oahu.

2. Between the shore and a line 850 feet distant seaward therefrom commencing at a point opposite Waikiki Tavern and running to a point opposite and seaward of the shore end of Cressaty's pier, the same distance from shore, no water craft as described in paragraph 1 shall be propelled by other than man power.

3. From the outer boundary described in paragraph 2 for a distance of 50 feet seaward, water craft described in paragraph 1 may be operated by its own power, but at a speed not to exceed 5 miles per hour.

4. Control of the operation of water craft is not contemplated beyond the boundaries set by this rule.

Average meteorological conditions at the Honolulu (T.H.) Observatory Station (lat. 21°19′ N., long. 157°52′ W.)

[Compiled by the U.S. Weather Bureau]

Month	Barometer at 32° F. and mean sea level: Mean: For month.	Barometer: Extremes: Highest	Barometer: Extremes: Lowest	Barometer: Extremes: Range	Air temperature: Mean: For month	Air temperature: Mean: Mean maximum	Air temperature: Mean: Mean minimum	Air temperature: Mean: Range	Air temperature: Extremes: Highest	Air temperature: Extremes: Lowest	Air temperature: Extremes: Range	Average relative humidity	Average amount of clouds, 0-10	Precipitation: Average fall	Precipitation: Number of days 0.01 inch or more	Precipitation: Maximum fall in 24 hours	Wind: Average hourly velocity	Wind: Highest velocity	Wind: Average number of times (observations at 8 a.m. and 8 p.m.) from—: N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calm	Number of days gales 40 miles or over	Number of days of fog
	In.	In.	In.	In.	°	°	°	°	°	°	°	%		In.		In.													
January	30.00	30.30	29.58	0.72	70.5	75.5	65.5	10.0	82	57	25	72	5.5	3.78	14	4.48	8.6	51	7	23	17	3	2	3	2	3	2	0.7	0
February	30.05	30.32	29.63	.69	70.7	75.9	65.6	10.3	84	56	28	72	4.8	3.75	11	3.46	8.0	48	5	23	15	2	2	3	2	2	2	.3	0
March	30.05	30.24	29.68	.56	71.1	76.2	66.0	10.2	82	57	25	70	5.6	3.20	13	13.52	8.5	42	5	32	14	2	1	2	2	2	2	.2	0
April	30.06	30.25	29.77	.48	72.7	77.6	67.7	9.9	82	60	22	68	5.4	2.11	13	3.79	9.2	40	2	29	22	2	1	1	1	1	1	.1	0
May	30.03	30.20	29.80	.40	74.6	79.6	69.6	10.0	85	63	22	68	5.2	1.74	12	1.94	8.3	48	2	30	21	3	1	1	2	1	1	0	0
June	30.03	30.18	29.84	.34	76.2	81.0	71.4	9.6	86	66	20	68	4.9	.92	13	3.67	8.5	40	1	28	26	2	1	1	0	1	0	0	0
July	30.02	30.15	29.82	.33	77.3	82.2	72.4	9.8	87	67	20	68	4.9	1.19	13	1.19	8.5	31	1	28	32	1	0	0	0	0	0	0	0
August	30.01	30.16	29.86	.30	78.1	83.0	73.2	9.8	88	66	22	68	4.6	1.28	13	1.12	8.5	36	1	30	27	2	0	1	0	1	0	0	0
September	30.00	30.15	29.82	.33	78.0	83.0	73.0	10.0	87	68	19	68	5.0	1.28	13	2.70	7.7	32	1	28	27	2	0	0	1	0	1	0	0
October	30.00	30.17	29.78	.39	76.8	81.7	71.8	9.9	87	63	24	69	4.8	1.55	14	4.58	7.3	42	1	30	24	2	1	1	1	1	1	0	0
November	30.03	30.16	29.75	.41	74.6	79.4	69.7	9.7	85	61	24	70	5.4	3.84	14	4.31	8.5	39	2	30	21	2	1	1	1	1	1	0	0
December	30.01	30.28	29.51	.77	72.6	77.3	67.8	9.5	83	59	24	72	5.3	3.96	16	4.83	8.5	53	5	26	20	3	1	2	1	2	2	.2	0
Mean	30.02				74.4	79.4	69.5	9.9				69	5.1				8.4												
Total														28.60	159				33	337	266	26	11	16	13	15	13	1.5	0

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