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U. S. COAST AND GEODETIC SURVEY
E. LESTER JONES, DIRECTOR

UNITED STATES COAST PILOT

THE HAWAIIAN ISLANDS



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NOTE.

The courses and bearings given in degrees are *true*, reading clockwise from 0° at north to 360°, and are followed by the equivalent *magnetic* value 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 per cent 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*.

Supplements and other corrections for this volume are issued from time to time and will be furnished, free of charge, on application to the Coast and Geodetic Survey, Washington, D. C., provided the volume itself has not been superseded by a subsequent edition.

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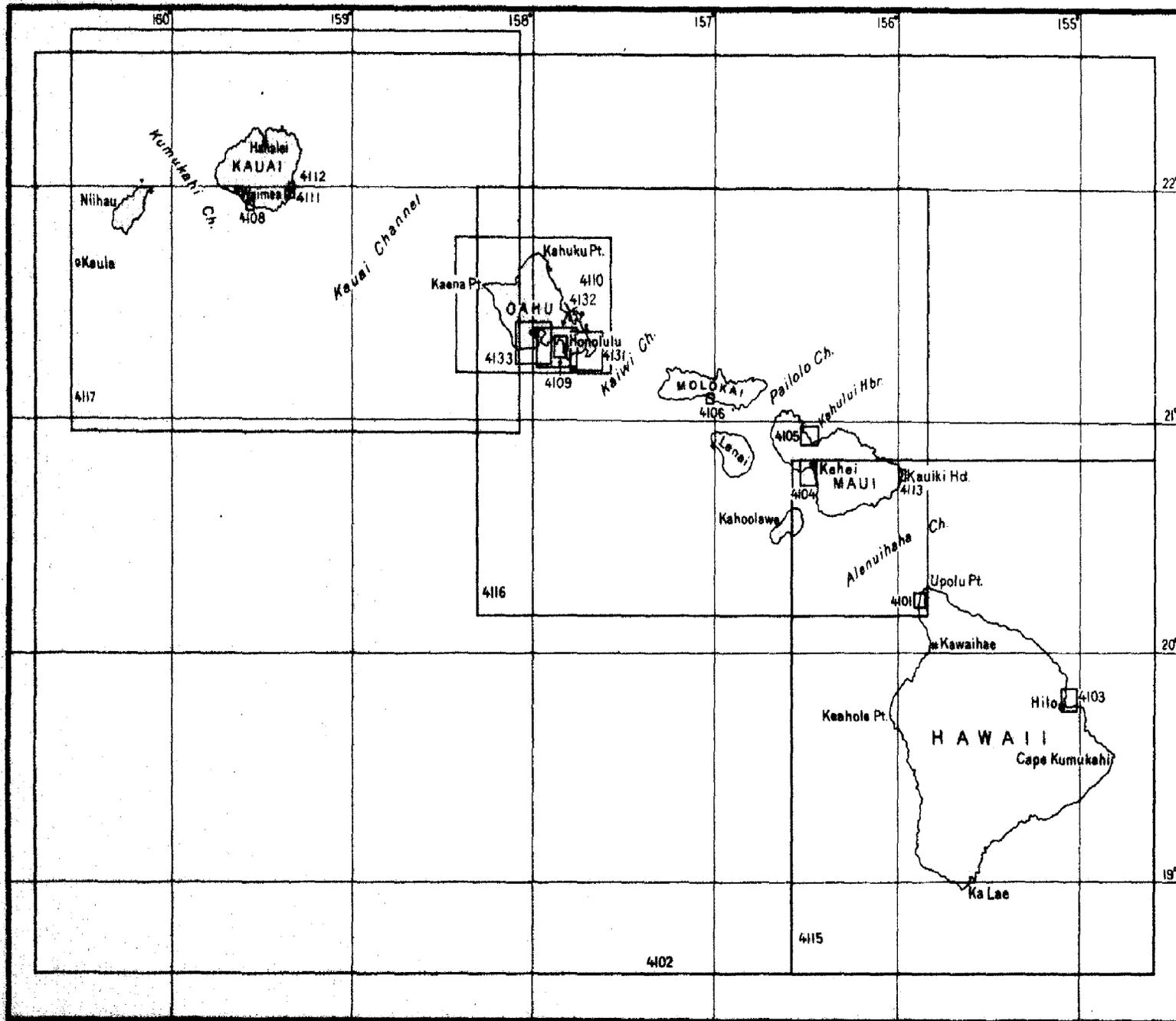
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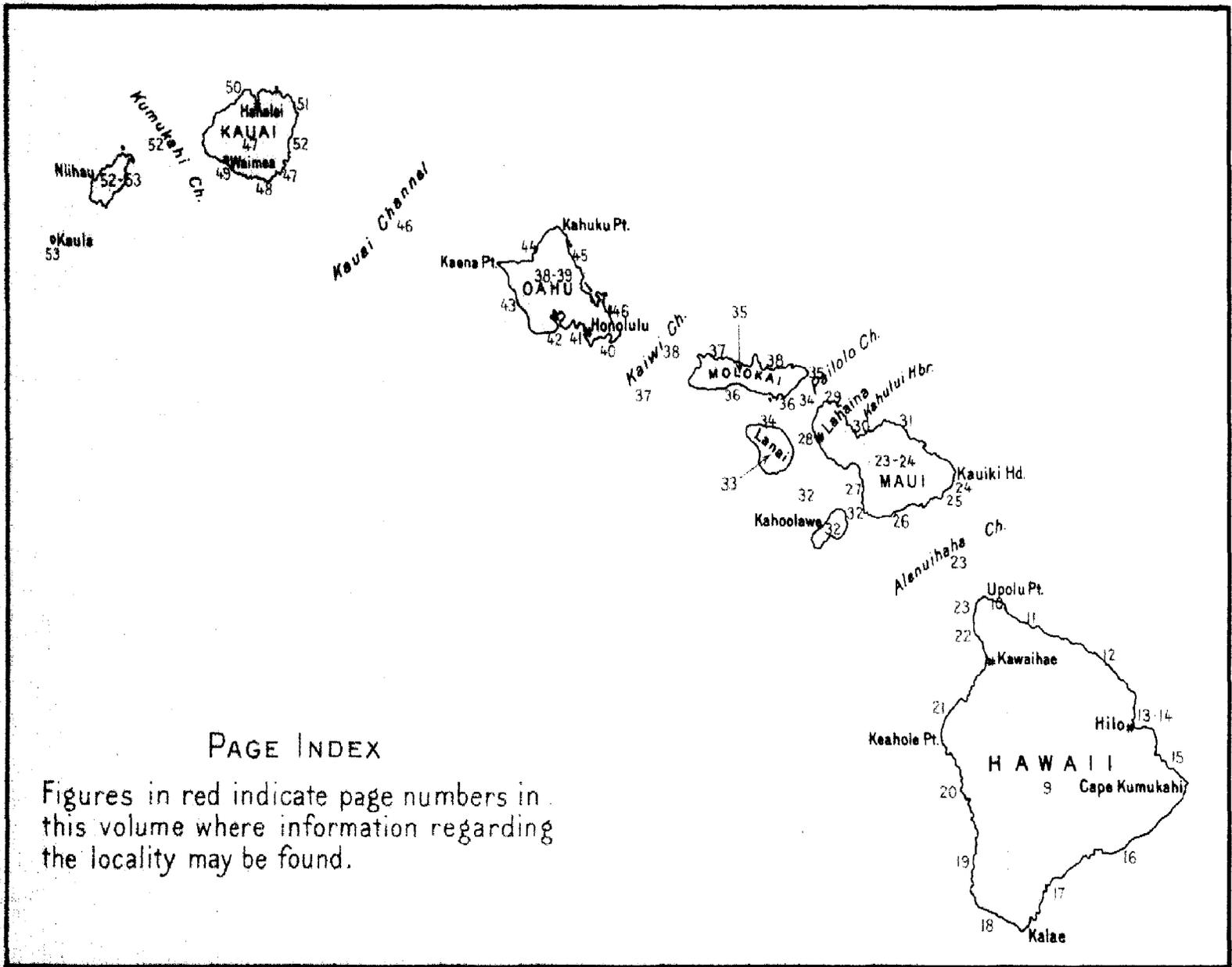
DEPARTMENT OF COMMERCE,
U. S. COAST AND GEODETIC SURVEY,
Washington, November 1, 1922.

This publication contains information relating to the Hawaiian Islands and includes the islands and reefs extending westward to Midway and Ocean Islands. It has been compiled by Lieut. G. C. Mattison, U. S. Coast and Geodetic Survey, under the direction of Commander P. C. Whitney, chief, coast pilot section, U. S. Coast and Geodetic Survey, from surveys by the Coast and Geodetic Survey, Geological Survey, and Hawaiian Government Survey; from U. S. Hydrographic Office publication No. 115, The Hawaiian Islands and the Islands, Rocks, and Shoals to the westward; and from the results of a special investigation made in 1922.

Great courtesy has been shown by local authorities and masters and pilots navigating these waters in furnishing information for use in this publication. The aids to navigation are corrected to March 30, 1923. Navigators are requested to notify the Director of the U. S. Coast and Geodetic Survey of any errors or omissions they find in this publication or of additional matter which they think should be inserted for the information of mariners.

E. LESTER JONES, *Director.*





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Figures in red indicate page numbers in this volume where information regarding the locality may be found.

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 $18^{\circ} 55'$ and $22^{\circ} 15'$ north latitude, and between $154^{\circ} 50'$ and $160^{\circ} 30'$ west longitude. The islands are 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 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.

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

CLIMATE.—Owing to the location of the islands, the climate is equable, the mean monthly temperature at Honolulu varying from $70^{\circ}.7$ in February to $78^{\circ}.1$ in August. (See table on page 89, giving average 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.

NOTE.—Instructions regarding "Navigational aids and the use of charts" and other useful data are contained in an appendix beginning at page 62.

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 onshore 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.

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 Alexander Young Building.

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 1919. This volume can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of \$1.

TIDES.—The periodic tides in this locality are usually small, the average rise and fall being from 1 to 2 feet. The high water intervals vary from 2 to 3¾ hours, and, in general, the tides occur from about an hour to an hour and a half earlier along the northern coasts than they do along the southern coasts of the islands. The Tide Tables, which are published annually in advance by the Coast and Geodetic Survey, contain the predicted tides for each day in the year for Honolulu and also tidal differences for a number of other places in the Hawaiian islands.

CURRENTS.—The currents are, as a rule, greatly influenced by the direction and strength of the trade winds. In general, there is a westerly set due to the prevailing northeasterly trade winds, but they are subject to considerable variations both in force and direction at different seasons. The tidal currents seem to have but little influence and are not generally taken into consideration.

POPULATION.—By the census of 1920 the islands had a population of 255,912.

PRODUCTS.—Agriculture is the principal occupation of the inhabitants. The principal products are sugar, pineapples, coffee, and cattle. 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, Maui; and Koloa, Kauai. The custom station for Koloa is at Eleele, locally known as Port Allen.

STANDARD TIME.—The standard time of the Hawaiian islands is 157° 30' west longitude time.

COMMUNICATION with San Francisco, Vancouver, Auckland, Sydney, Manila, Yokohama, and Hongkong 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 Isthmus of Tehuantepec via San Francisco. There is frequent communication by interisland vessels around the islands.

RAILROADS.—A railroad skirts the shores of Oahu westward from Honolulu along the southwesterly and northwesterly sides and half-way 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.

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

CABLE.—There is communication by cable to San Francisco and to Manila via Midway and Guam. There is good telephone service on all the large islands.

WIRELESS TELEGRAPH.—There is wireless telegraph communication between the islands and with the United States and the Orient.

QUARANTINE.—National quarantine laws are enforced in the islands by officers of the United States Public Health Service.

MARINE HOSPITAL.—There is a relief station of Class II of the United States Public Health Service at Honolulu. The office is in the customhouse.

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.

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. For a description of all aids see the Buoy List, Hawaiian and Samoan Islands, published by the Lighthouse Service, which can be obtained from the Superintendent of Documents, Washington, D. C., price 20 cents, or from the agents listed in the weekly Notice to Mariners.

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. Dredging buoys are white, with the tops for a distance of 2 feet painted green.

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.

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.

TOWBOATS.—There are no seagoing towboats in the islands. The local steamers do towing. In some of the harbors there are large launches which sometimes assist lighters and vessels when inside.

SUPPLIES.—Provisions, ice, lumber, and some ship-chandler's stores can be obtained at Honolulu, Hilo, and Kahului. Some provisions can be obtained at other places.

WATER can be conveniently obtained at Honolulu, Hilo, and Kahului. Water can be obtained also from streams at many places.

FUEL.—Coal and fuel oil (for vessels) can be obtained at Honolulu, Hilo, and Kahului.

REPAIRS.—There are machine shops at Honolulu, Hilo, and Kahului, and ordinary repairs to machinery can be made. There is a floating dry dock at Honolulu with a dead-weight capacity of 4,500 tons.

WHARVES AND LIGHTERS.—At several of the ports there are wharves at which vessels can lie to discharge and load, but at all others vessels discharge or load either by lighters or wire cable.

RADIO SERVICE.

TIME SIGNALS.—In connection with the service over the land telegraph lines, time signals by radio are sent daily, Sundays and holidays excepted, from certain United States naval coastwise radio stations on the Pacific coast and at Honolulu, as follows:

Stations.	Time.	Standard meridian.	Wave lengths.
			<i>Meters.</i>
San Francisco, Calif.	Noon.....	120 00	1,908
	10 p. m.....	120 00	4,650
San Diego, Calif.	Noon.....	120 00	1,988
			9,800
Honolulu, Hawaii.....	1.30 p. m.....	187 30	2,250
			11,500

The signals begin at 5 minutes before the hour and continue for 5 minutes. During this interval every tick of the clock is transmitted except the twenty-ninth second of each minute, the last 5 seconds of each of the first 4 minutes, and finally the last 10 seconds of the last minute. The final signal is a longer contact after this long break. Hydrographic information, weather reports, and other information of benefit to shipping are sent out from these stations.

The supervision of radio communication in the United States, including the Hawaiian Islands, is controlled by the Bureau of Navigation, Department of Commerce. A list of the radio stations of the United States, including shore stations, merchant vessels, and Government vessels; Radio Communication Laws and Regulations of the United States; and Amateur Radio Stations of the United States are published by that bureau. Any of these publications can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.; price, 15 cents each. Changes or additions to the stations and to the laws and regulations are published in bulletins issued monthly; price, 5 cents per copy or 25 cents per year.

The International List of Radio Stations of the World (edition in English) can be procured from the International Bureau of the Telegraphic Union (Radiotelegraphic Service), Berne, Switzerland. In addition to the information contained in the list of the United States stations published by the Bureau of Navigation, the international list shows geographical locations, normal ranges in nautical miles, radio systems, and rates. Supplements to the international list will be issued monthly and will contain new stations and tables of alterations. Inquiries as to the subscription prices of these lists should be made direct to the Berne bureau at the address given above. Remittances to Berne should be made by international postal money orders.

RADIO COMPASS BEARINGS.—The Naval Communication Service will furnish radio bearings to mariners of all vessels equipped with radiotelegraph transmitters. While the use of these bearings should not lead a mariner to neglect other precautions, such as the use of the lead, etc., during a fog, these bearings will greatly reduce the dangers to navigation for mariners who are compelled for any reason to proceed during foggy or misty weather.

These radio compass stations are provided, primarily, to assist the mariner in closing the land during fog or poor visibility, but they may also be used to obtain the positions of vessels at sea in radio compass range, about 150 miles, when for any reason positions can not be obtained by other means. The maximum distance for which bearings from these stations are accurate is 150 miles. But accurate positions can not be plotted when more than 50 miles from the shore on Mercator charts, for the Mercator projection introduces a distortion of the true bearing.

For plotting radio compass bearings the U. S. Coast and Geodetic Survey publishes three plotting charts, which may be obtained by application to the Director, Coast and Geodetic Survey, Washington, D. C., or the sales agents, price 20 cents each. Full directions for using them are printed on the reverse side of each chart.

Radio compass stations are divided into two classes: (a) Single stations, operating independently and furnishing a single bearing. These stations are located with the view of giving service to ships at a distance of not over 150 miles from the station. (b) Harbor entrance groups. All stations in harbor entrance groups are connected to and controlled by the master station. All stations of the group take bearings simultaneously and these bearings are transmitted to the ship requesting them by the control station. The purpose of

these stations is to lead mariners to the light vessels off harbor entrances.

Where only one radio compass station is available, the mariner may fix his position by two or more bearings from the station with the distance run between, or may use the bearings as a line of position, or as a danger bearing. Or the bearing may be crossed with a line of position obtained from an observation of an astronomical body to establish a fix.

Wave lengths.—All independent and group radio compass stations keep watch on 800 meters. Only this wave should be used to call and work with these stations.

Calling a radio compass station.—To obtain a bearing from independent radio compass stations, call the station from which the bearing is desired in the usual manner and request bearings by means of the conventional signal given hereafter. Simultaneous bearings from two or more compass stations can be obtained by making the call include the other compass stations desired. To obtain bearings from the harbor entrance compass stations, carry out the procedure previously given. The compass control station only will answer.

Conventional signals.—The following abbreviated signals will be used:

Signal.	Meaning.
QTE?.....	What is my true bearing?
QTE.....	Your true bearing is degrees from radio compass station.

The following radio compass stations will be of use for vessels approaching the Pacific coast of the United States:

Stations.	Call letters.	Position.
Cattle Point, Wash. ¹	NFN	Lat. 48° 27' 04" N., lon. 122° 57' 45" W.
Smith Island, Wash. ¹	NFH	Lat. 48° 19' 04" N., lon. 122° 50' 39" W.
New Dungeness, Wash. ¹	NFT	Lat. 48° 10' 36" N., lon. 123° 07' 51" W.
Fort Angeles, Wash. ²	NFT	Lat. 48° 08' 30" N., lon. 123° 24' 19" W.
Tatoosh, Wash.	NPD	Lat. 48° 23' 41" N., lon. 124° 44' 13" W.
Ocean Park, Wash. ²	NPE	Lat. 46° 27' 53" N., lon. 124° 03' 16" W.
Fort Stevens, Oreg.	NPE	Lat. 46° 11' 32" N., lon. 123° 59' 15" W.
Empire, Oreg. ²	NPF	Lat. 43° 23' 03" N., lon. 124° 18' 58" W.
Eureka, Calif.	NPW	Lat. 40° 41' 48" N., lon. 124° 16' 34" W.
Point Reyes, Calif.	NLG	Lat. 38° 02' 13" N., lon. 122° 59' 36" W.
Bird Island, Calif.	NLD	Lat. 37° 49' 27" N., lon. 122° 32' 12" W.
Point Montara, Calif.	NLH	Lat. 37° 32' 02" N., lon. 122° 31' 07" W.
Farrallon Island, Calif.	NPI	Lat. 37° 41' 58" N., lon. 122° 59' 58" W.
Point Arguello, Calif.	NPK	Lat. 34° 34' 43" N., lon. 126° 38' 51" W.
Point Hueneume, Calif.	NMD	Lat. 34° 08' 43" N., lon. 119° 12' 30" W.
Point Fermin, Calif.	NPX	Lat. 33° 42' 19" N., lon. 118° 17' 38" W.
Point Loma, Calif.	NPL	Lat. 32° 42' 21" N., lon. 117° 15' 17" W.
Imperial Beach, Calif.	NPL	Lat. 32° 35' 14" N., lon. 117° 07' 54" W.

¹ Limited service. Standing watch during thick and heavy weather.

² Out of commission at present. Notice will be given when operation is resumed.

³ Limited service. Standing watches: 0000 to 0200; 0400 to 0600; 0800 to 1400; and 1500 to 2200 (G. M. T. civil).

PROCEDURE IN DETAIL.

(a) A ship calling the radio compass station or compass control station should make the abbreviation "QTE?" ("What is my bearing?"). This request will be answered by the radio compass station or control station, and when ready to observe the radio bearing it will send the signal "K," indicating to the ship to commence "testing"; i. e., repeating its distinguishing signal for a period of 50 seconds. The signal should be made slowly with the dashes considerably prolonged.

(b) The testing should be made on 800 meters, upon the completion of which the ship should await reply from the radio compass station.

(c) The radio compass station or control station will then reply, repeating the abbreviation "QTE" ("Your bearing from was degrees"), followed by the bearing in degrees given by a group of three figures 000 to 360, indicating the true bearing in degrees of the ship station from the radio compass station, and then the time group giving the time of observations in local standard time. In the case of more than one radio compass connected by land line only, the station originally called will answer. This station will combine all the bearings taken by itself and associated stations into one message, which gives each bearing observed immediately after the name of the station making the observation. *All compass stations transmit on 800 meters.*

Danger from reciprocal bearings.—Attention is invited to the fact that when a single bearing is furnished there is a possibility of an error of approximately 180° , as the operator at the compass station can not always determine on which side of the station the vessel lies. Certain radio compass stations, particularly those on islands or extended capes, are equipped to furnish two corrected true bearings for any observation. Such bearings when furnished vessels may differ by approximately 180° , and whichever bearing is suitable should be used.

Caution.—Mariners receiving bearings which are evidently the approximate reciprocal of the correct bearing should never attempt to correct these bearings by applying a correction of 180° , as such correction would not include the correction necessary on account of deviation at the compass station. An error of as large as 30° may be introduced by mariners applying an arbitrary correction of 180° to such bearings. Vessels receiving bearings manifestly requiring an approximate 180° correction should request the other bearing from the radio compass station if not previously furnished.

Bearings, except in the case of approximate reciprocal bearings, should be accurate within 2° of arc provided the transmitting equipment on board vessels is tuned sharply to 800 meters. Operators should use sufficiently wide coupling to obtain low decrement. If radio transmitters are not tuned sharply, it is difficult to obtain bearings that are sufficiently accurate for navigational purposes. When bearings from three or more compass stations are not over 2° of arc in error, but do not meet at a fixed point, the geometric center of the triangle formed by the bearings can generally be taken as the approximate position of the vessel. Mariners until thoroughly familiar with the system are advised to use radio compass stations

frequently, especially in clear weather, when positions of vessels can be accurately fixed in order to accustom operators to the procedure and to acquaint themselves with the degree of accuracy and dependability of bearings furnished by the radio compass stations.

Reports.—In order that the operation of shore radio compass stations may be checked, mariners obtaining bearings are requested to forward a brief report to the Director Naval Communications, Navy Department, Washington, D. C., containing the following particulars:

1. Name of ship.
2. Name of radio compass station.
3. Date and local standard time at which radio bearing was taken.
4. Bearings given by radio station.
5. Estimated position of ship at above time and dates by methods other than radio.
6. The probable degree of accuracy of the estimated position.
7. Weather conditions at above time.
8. Remarks, if any.
9. Signature of master or responsible navigating officer.

There is no charge for bearings furnished by the U. S. Naval Radio Compass Station.

RADIO FOG SIGNALS.—The following radio fog signal is operated on the Pacific coast by the United States Lighthouse Service: San Francisco Light Vessel, Calif.—Series of double dashes for 30 seconds, silent 30 seconds.

These radio fog signals are intended for the use of vessels equipped with radio compass. By reason of this radio compass (also termed radio direction finder) the bearing of the radio fog signal station 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 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 caused 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.

The signals from the light vessels have definite characteristics for identifying the stations, as have the flashing lights and sound fog signals, and bearings may be obtained with even greater facility than sight bearings on visible objects. The radio fog signals are transmitted on a wave length of 1,000 meters, which is exclusively reserved for this purpose to avoid interference. The stations transmit continuously during thick weather and also for one-half hour twice each day, beginning at 9 a. m. and 3 p. m., regardless of weather conditions.

A general description of this method of navigation and the instruments required may be obtained from the Commissioner of Lighthouses, Washington, D. C., upon request. The Bureau of Standards Scientific Paper No. 428, the Radio Direction Finder and Its Application to Navigation, may be obtained from the Superintendent of Documents, Washington, D. C., for 15 cents.

HAWAII,

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 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, while in the northwestern part Mount Kohala, elevation 5,505 feet, 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 almost reach the coast, and in the various cinder cones dotting the slopes. The only active volcanos in the Hawaiian group, Mauna Loa and Kilauea, are located on this island.

RIVERS.—There are numerous streams on the east coast, but none are navigable except for boats and small craft.

POPULATION.—By the census of 1920 Hawaii had 64,895 inhabitants.

WINDS.—The easterly trade winds seems 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 off shore. Sailing vessels from westward bound to ports on the eastern side of Hawaii should keep well northward until clear of Alenuihaha Channel.

RAINFALL.—The rainfall of Hawaii varies greatly in different localities. The greatest 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 condition being shelter from the northeast trades.

SUPPLIES.—Provisions, ice, lumber, and some ship chandler's stores can be obtained at Hilo. Some provisions can be obtained at other places.

WATER can be conveniently obtained at Hilo.

COAL and fuel oil for vessels can be obtained at Hilo.

REPAIRS.—There is a machine shop at Hilo, where vessels can make extensive repairs.

COMMUNICATION with Honolulu by a regular line of steamers can be had several times a week.

RAILROADS extend northwestward, southeastward, and southward from Hilo. There is a railroad that follows the coast from Mahukona around the north end of the island to within 1 mile of Akoko Point.

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

TELEPHONE.—There is communication by telephone to all parts of the island and by wireless telegraph to the other islands.

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 off shore southwestward from Cape Kumukahi around Kalae and northward as far as Upolu Point. There is also a counter-current inshore that sets southward from Okoe Landing along the west coast around Kalae, and thence northeastward along the shore as far as Keauhou.

NORTHEAST COAST OF HAWAII.

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 Honokaneike 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 the freight is handled by local vessels, and at most of these, vessels load 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 sugar cane, and here and there may be seen clumps of trees, among which are generally situated the mills, camps, and villages.

Kauhola Point, 7 miles eastward of Upolu Point, is a low point of land marked by a flashing white light, off which a dangerous reef, generally marked by breakers, extends $\frac{1}{3}$ 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, with Kauhola Point light bearing 90° true (E by N mag.), distant $\frac{1}{3}$ mile. In leaving this anchorage, bound eastward, steer 10° true (N mag.) for $1\frac{1}{4}$ miles to clear the reef.

Keokea (white) Harbor, $1\frac{1}{2}$ miles southeast of Kauhola Point, is an abandoned shipping point. It can not 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 table-land, 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, 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, $\frac{1}{2}$ mile from Pololu Gulch, is used somewhat for taro raising.

Honokaneike Gulch, $1\frac{1}{2}$ 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 0.4 mile offshore and $1\frac{3}{4}$ 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. The depth of the surrounding water is from 12 to 14 fathoms. Two small rocky islands, the larger having a height of 230 feet, are situated 300 yards offshore, about $\frac{3}{4}$ mile east of Honokaneike Gulch. Between Akokoa Point and these two islands the bottom is fairly regular and slopes gradually from the coast to the 20-fathom curve, about $\frac{3}{4}$ mile offshore. Anchorage may be had in offshore winds in depths from 7 to 20 fathoms.

Laupahoehoe, 6 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.

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 an anchorage in favorable weather. A depth of 7 fathoms is obtained $\frac{1}{4}$ 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. 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 $\frac{1}{4}$ mile offshore, either off the mouth of the valley or under the bluffs to the eastward, but not beyond **Honokaape Point**, located $\frac{3}{4}$ mile beyond the east edge of the valley.

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 high. Between Waipio Gulch and Hilo the country to an elevation of about 2,000 feet is covered with sugar cane. Beyond this, extending upward toward Mauna Kea, it is wooded to an elevation of about 2,600 feet, and from here up the mountains present a barren appearance.

Kukuihaele Landing, 2 miles eastward of Waipio Gulch, is marked by a flashing white light. There is a wire landing here where miscellaneous freight is handled.

Honokaa Landing, 5 miles southeastward of Kukuihaele Landing, is marked by several buildings on the bluff. Southeastward and close to the landing is a high bridge over a deep gulch. A mill is located 1 mile southward of the landing. A wire landing is used for handling sugar and general freight. This indentation forms a fair shelter for small boats and launches, as some protection from the northeast trade winds is afforded by the point.

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 is situated on the lowland south of the landing. A deep gulch makes in on each side of the mill. The southern one is spanned by a bridge. There is a wire landing here.

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.

Koholalele Landing, $5\frac{1}{2}$ miles southeastward of Paauhau, is marked by a building at the top of the bluff and by another half way down. It is difficult to recognize from offshore. This is an excellent landing for small boats, as they can lie at the derrick pier, where they are well protected from the northeast trade winds. The inclined railway cut offers easy access to the top of the cliff.

Kukaiau mill is about $\frac{3}{4}$ mile southeastward of Koholalele. An inclined railway leads from a house on top of the bluff to a derrick at its foot. The bluffs are higher and more thickly covered with vegetation than those northwestward.

Ookala mill, $3\frac{1}{2}$ miles southeastward of Kukaiau mill, is on the edge of the bluff on the south side of a deep gulch. The plantation houses are situated north of the mill and are noticeable for the regular arrangement.

Kaawalii Gulch, about $1\frac{1}{2}$ miles southeast from Ookala mill, is V shaped. There is a small mill 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 $\frac{1}{4}$ mile from a deep gulch. The seaward end of the point is a mass of black lava rock. A reef, over which the sea generally breaks, extends about $\frac{1}{4}$ mile offshore. Laupahoehoe village is located on the inshore end of the point. There is a coconut grove between the village and the end of the point and one on the north side of the mouth of the gulch. A church, painted yellow, with a red roof and a square yellow tower, is prominent. Small boats can land here at almost any time, under the lee of the rock point on which the derrick and the freight house are situated.

Papaaloa, $1\frac{1}{2}$ miles southeast from Laupahoehoe, can be easily identified by the stacks close together, one of concrete, white in color, the other of metal, painted black, situated at the mill.

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. There is a derrick and wire landing at this place. The land has lost its hummocky appearance, and the cane-covered fields have a more level appearance, but are still broken by the gulches. The bluffs lose their green vegetation and are beginning to have a dark color. Between here and Hilo the cliffs gradually decrease in height until at Hilo the bluffs disappear.

Hakalau Bay, about $8\frac{1}{2}$ 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

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.

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 $2\frac{1}{4}$ miles southeastward of Hakalau Bay, is situated in the mouth of the gulch. About 2 miles northward of **Pepeekeo** Point the waterfalls cease to be a characteristic of the coast.

Alia Point, $1\frac{3}{4}$ miles southeastward of **Honomu** mill, is not very prominent.

Pepeekeo Point, marked by a group flashing white light, is about $2\frac{1}{2}$ 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.

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 concrete building with a red roof.

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

Paukaa Point, about 1 mile south of **Papaikou**, is marked by a fixed white light at an elevation of 155 feet. This light is difficult to distinguish, owing to the many lights in the vicinity.

HILO BAY,

about 60 miles southeastward of **Upolu** Point and 20 miles northwestward of **Cape Kumukahi**, is included between **Keokea** Point on the south and **Pepeekeo** Point on the north, a distance of 7 miles, and indents the coast about 3 miles. It is the leading commercial port of the island and is frequented by both steam and sailing vessels. The bay is partially sheltered from the prevailing northeast trades by a breakwater on **Blonde Reef**, although there is frequently a heavy swell. It is exposed to north winds. The westerly shore of the bay is bluff, while the southerly and easterly shores are low.

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 **Kuhio Wharf**. There is a landing for lighters in **Waiakea** Creek.

PROMINENT FEATURES.—**Hilo** Sugar Co.'s mill, about 1 mile northward of **Hilo**, 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 with a white derrick on it. 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 is covered with sugar cane and a few scattered trees. On the north side below the summit is a depression resembling a crater.

RANGES.—A lighted range marks the channel south of **Blonde Reef** to the railroad wharf in **Kuhio** Bay.

PILOTAGE is not compulsory, but vessels without coasting license are required to pay half fee when a pilot is not taken. The pilot rate is given in the **Appendix**.

TOWBOATS.—Two small towboats are available for towing. The small freight steamers of the interisland service also do towing when required and when available.

ANCHORAGE can be had in the bay anywhere under the lee of Blonde Reef in from 5 to 7 fathoms. After heavy rains a strong current setting northward from Waiakea Creek is felt in the southeasterly part of the bay.

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, as well as fuel oil and a limited amount of coal, can be obtained, and water from hydrants on the railroad wharf at Kuhio.

REPAIRS.—There is a machine shop where extensive repairs can be made.

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.

DIRECTIONS.—*From eastward*, give Leleiwi Point a berth of 1 mile in rounding it and steer 280° true ($W \frac{1}{8} N$ mag.) for $4\frac{1}{2}$ miles, heading for Paukaa light until $\frac{1}{2}$ to $\frac{3}{4}$ mile from shore; then steer 184° true ($S \frac{1}{2} E$ mag.) keeping this distance offshore and taking care to pass westward of Blonde Reef gas and bell buoy. Anchor southward of the black can buoys, marking the southwesterly edge of Blonde Reef, with the Hilo Sugar Co.'s mill bearing 293° true ($WNW \frac{3}{4} W$ mag.), in 6 fathoms. Or, if bound for the railroad wharf in Kuhio Bay, after passing Blonde Reef gas and bell buoy haul eastward slowly, leaving black buoy (can, 7) to port. Then steer 97° true ($E \frac{1}{8} N$ mag.) with Kuhio Bay Range Lights ahead. Pass between the buoys marking the edges of the shoals on each side of the channel. In 1922 this channel had a depth of 33 feet. There is 34 to 37 feet along the wharf.

From northward, after rounding Pepeekeo Point, steer 184° true ($S \frac{1}{2} E$ mag.), keeping $\frac{1}{2}$ to $\frac{3}{4}$ mile offshore and taking care to pass westward of Blonde Reef gas and bell buoy and anchor 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 Coconut Island.

Blonde Reef is an extensive sunken reef, with depths of 1 to 3 or 4 fathoms, which extends $1\frac{1}{2}$ 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 can not be depended on to clear it. It is marked at its westerly end by a black gas and bell buoy and on its southwesterly edge by two black can buoys. A breakwater is under construction from the easterly shore over Blonde Reef to its westerly end. The entrance to the bay is $\frac{3}{4}$ mile wide between Blonde Reef and the westerly shore. There is no safe passage across the reef.

Mokuola (Coconut) Island (wooded) and the bare islets 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 gas buoy. Shoals with 7 to 15 feet extend out a distance of $\frac{1}{8}$ to $\frac{1}{4}$ mile all along the southerly side of the bay.

Keokea Point, about 3 miles eastward of Hilo, is low and hard to distinguish from other points in the vicinity. There are a few coconut trees on the point. Foul ground extends for $\frac{1}{2}$ mile offshore.

Leleiwi Point, 5 miles eastward of Hilo, is marked by a mass of bare, black lava rock about 20 feet high, which extends 100 yards seaward from the tree line. 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, $6\frac{1}{2}$ miles southward of Leleiwi Point and $3\frac{1}{2}$ miles inland, is prominent. 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, 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 northwestward of Cape Kumukahi, is marked on its seaward end by two black hills about 50 feet 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 coconut 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. The end of the point is marked by a group of sharply defined pinnacles which are only visible when close inshore. A series of old blowholes, or craters, begin 2 miles southwestward of the cape and extend 5 miles in a southwesterly direction. The blowhole nearest the point is surmounted by a grove of coconut 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.

SOUTHEAST COAST OF HAWAII.

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. Punaluu and Honuapo are the only landings where the local 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 blowholes or craters, heretofore mentioned as extending southwestward from the cape, join the ridge which forms the divide between the Puna and Kau districts.

Pohoiki Landing, 4 miles southwestward of Cape Kumukahi, is marked by a prominent coffee mill. There is a thick mass of green foliage on a small point in front of the mill. There is a good landing place at the remains of a concrete pier.

Kapoho, a settlement about 2 miles west of Cape Kumukahi, is the terminus of the Hilo Railroad. A spur runs to Pahoā, 7 miles farther west.

Honuaula Crater, about 5 miles southwestward of Cape Kumukahi and 3 miles inland, has its southeast side blown out and its southerly side covered with vegetation; it is quite prominent.

Opihikao Village, about 7 miles southwestward from Cape Kumukahi, is marked by a prominent grass-covered mound, 125 feet high, near the beach about 1 mile northeastward of the village. The village is situated in a coconut grove. In the village are two churches, with steeples, about $\frac{1}{8}$ mile apart.

Kaimu Village, about 6 miles southwest of Opihikao, has a fine sand beach that may be used as a landing place. The beach is steep and free from rocks.

Kalapana Village, 7 miles southwestward of Opihikao and on the northeasterly side of a bold flat-topped headland, the most prominent point in this vicinity, is situated on low ground back of a sand beach. In front of the village and near the beach is a church with a steeple. About $\frac{1}{4}$ mile northeastward of the village is a thick grove of pandanus trees. When coasting from southwestward, the village will not be seen until almost abeam.

Kii Village, $2\frac{1}{2}$ miles southwestward of Kalapana, consists of a few scattered houses between which are coconut trees.

Apua Point, 12 miles southwest of Kii, is a low bare point. Shoal water extends off the point for 300 yards or more.

Keauhou Landing is $2\frac{1}{2}$ 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 high at its northeasterly end. This is the most prominent landmark near the beach on this part of the coast. One mile 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 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 can not 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 lava flow of 1823 from Mauna Loa marks the western limits of the desert. 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.

Pahala mill, about 4 miles northward of Punaluu and 3 miles from the coast, is prominent. The country in the vicinity of the mill is covered with sugar cane to an elevation of about 2,000 feet; beyond this it is wooded up the mountain side to within about 6,000 feet of its summit. Here and there bare lava flows cut up the cane fields.

Punaluu Landing, about 17 miles southwestward of Keauhou, is marked by a large warehouse close to shore. There is a church with a steeple on the steep slope near the beach on the west side of the anchorage. A small village located in a coconut grove lies in the

mouth of the deepest gorge. The local steamer calls here. A plantation railroad runs from the landing to Pahala mill. Back of the landing up to an elevation of about 3,500 feet the slopes are broken; above this they are regular and gradual to the summit of Mauna Loa.

Enuhe Butte, about 3 miles northwestward of Punaluu, is a cone about 700 feet high with its flat top tilted seaward and covered with sugar cane; its sides are covered with vegetation. The top of the cone, which appears to set at an angle to the slope on which it rests, has an elevation of about 2,327 feet.

Kaumaikēohu Peak, about 5 miles northward of Punaluu, is a prominent cone situated within the forest line.

Honuapo Landing, $4\frac{1}{2}$ miles southwestward of Punaluu, is marked by a wharf which has a long low building at its inshore end. The local steamer calls here. Back of the landing is a mill and westward, near the beach, is the village. Some of the slopes back of the landing are covered with sugar 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 2 miles and the larger one 4 miles from the landing.

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 $\frac{1}{4}$ mile off the point. Between Kaalualu and the South Cape is a grassy plain occasionally broken by bare lava spots.

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 88° true (E by N mag.), distant about 200 yards, anchorage may be had in about 10 fathoms. Between the anchorage and the landing, 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.

Kalae (South Cape), 5 miles southwestward of Kaalualu Bay, a low, grass-covered point, is marked by a fixed 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, where it leaves the shore and trends inland for several miles, continuing its increase in height. Shoal water extends for $\frac{1}{2}$ mile south of the point, and all vessels should keep 1 mile off to avoid possible dangers. On account of the current, which sets northeastward against the trade winds, it is generally rough on the easterly side of the cape.

WEST COAST OF HAWAII.

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 $\frac{1}{2}$ mile wide, is in Kawaihae Bay. North of Keahole Point there is much foul ground; otherwise, off the numerous capes and points the reefs do not make out over $\frac{1}{4}$ mile, and all dangers may be avoided by giving the coast a berth of about 1 mile, except north of Keahole Point.

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, and there are large areas covered with sugar cane and coffee. Below the 1,500-foot level there is very little vegetation. Many of the lava flows reach the coast and terminate in bluffs, and between them along the beach will be seen trees and other vegetation.

At an elevation of 2,000 feet 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. 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.

Waiahuakini, 2 miles north of Kalae, is a small fishing village at the base of the cliffs. There is a landing here in a small cove.

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.

Kaulanamauna, 4 miles northwest of Pele Hills, affords a landing place. There are a few houses 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 landing is close to the houses.

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.

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. Offshore, on the southeast coast, the current sets southwestward. 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 church with steeple, in the southerly end of the village, and a number of houses which are situated in and around a coconut grove. In front of the village there are several strips of sand beach.

Hoopuloa Landing, $2\frac{1}{2}$ miles northward of Hanamalo Point, is marked by a road which zigzags up the mountain in the rear of the village. The village is located in a coconut grove. There is a wharf at the head of the bay. The local steamer makes regular calls here, coffee and sugar being the principal exports. Anchorage may be had, close in, in 15 fathoms. A reef extends off the southerly point of the bay. Two private red lights are displayed on steamer nights as a guide to the anchorage. These brought in range lead to the anchorage. Along the coast in the vicinity may be seen jagged black masses of lava at the foot of the bluffs along the beach. Above the steep lava slopes, which are characteristic of this section of the coast, there is a heavily-wooded table-land from which rises the dome of Mauna Loa. About 2 miles north of Hoopuloa the 1919 lava flow stands out prominent, as it is the blackest of any of the flows in the vicinity.

Lepeomoa Rock, $8\frac{1}{2}$ miles northward of Hoopuloa, is located at the water's edge; it is the ruin of an old crater and is crescent shaped, with its seaward face blown out. The rock is about 95 feet high.

Kauhako Bay, about $2\frac{1}{2}$ miles northward of Lepeomoa Rock, is marked at its head by a pali, or cliff, which is about $\frac{1}{2}$ mile long and about 120 feet 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, sandy bottom, about 300 yards off the village. There is a wharf near the north end of the sand beach. The local steamer calls regularly, general farm produce being shipped. Some coffee is shipped from here. A private red light is displayed on steamer nights. 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 100 feet 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.

Honaunau Bay, 3 miles northward of Kauhako Bay, lies between two flat lava points, the southerly one being the lower and smaller. A coconut grove and a few houses are located here. About $1\frac{1}{2}$ miles inland on the slopes are three or four large tobacco warehouses.

Palemalo Point, on the south side at the entrance to Kealakekua Bay, is low and flat with a coconut grove near its end. About $\frac{3}{8}$ mile northward of the point an old lava flow makes down to the beach; this flow is about $\frac{3}{8}$ mile wide.

Kealakekua Bay, 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 Keawekahaka 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 high and about $\frac{1}{2}$ mile long. **Kaawaloa Cove** is the northerly part of the bay and lies between the high cliff and Cook Point.

The villages of **Napoopoo** and **Kealakekua** consist of a few houses scattered along the beach 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 is in the middle of the village alongside of a low shed, but during a heavy swell it is best to land on the sand beach either at the north end of the village or the one southward. **Cook Monument** is a concrete shaft, 25 feet high, located near the shore on the inner side of Cook Point. The local steamer makes regular calls here, the principal exports being coffee and tobacco, as well as general farm produce.

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 $\frac{7}{8}$ 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 10 to 15 fathoms, with the south end of the cliff bearing 55° true (NE mag.) and Cook's Monument bearing 314° true (NW by 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. North of Napoopoo there are more sugar plantations and less of coffee.

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 about 230 feet high, located near the beach, about $1\frac{1}{2}$ 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, $2\frac{1}{4}$ miles northward of Keawekaheka Point, is low, black, and jagged with coconut trees on it. Behind the point the mountain side is covered with cane to an elevation of about 1,000 feet.

Keauhou Bay, $2\frac{1}{2}$ miles northward of Keikiwaha Point, is a small indentation in the coast, lying between two lava flows at the foot of a gentle slope which has coconut trees on it near its base and algaroba trees just above them. There is an indifferent anchorage, but it is not recommended. The boat landing is on the northeasterly side of the bay, in the vicinity of which are a few houses. There are no spires or prominent objects that may be of assistance in recognizing Keauhou from offshore. **Kahaluu**, a small village 1 mile to the north has a prominent white spire. The local steamer calls regularly at Keauhou.

Mount Hualalai, in the central western part of Hawaii, is a conical peak, 8,269 feet high, covered with vegetation to its summit, and is prominent from any point of approach. Its western slope terminates 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, 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 northward to Kawaihae Bay. The bay affords good anchorage except during kona weather. The landing is on the northerly side of the bay alongside a wharf with a shed on it. **Kailua** village is situated along the shore of the bay and next to Hilo is the most important town on the island. Provisions and water can be obtained in limited quantities, as well as gasoline and some ship chandlery. A prominent church with red roof surmounted by a tower with red steeple stands about 100 yards from shore in the northerly part of the town. The local steamer makes regular calls here, the principal exports being sugar, coffee, and cattle.

APPROACHING FROM SEAWARD, steer for Mount Hualalai on a 66° true (NE by 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 church described in the preceding paragraph on a 33° (NNE mag.) course and anchor in 10 fathoms, sandy bottom.

Keahole Point, 7 miles northwestward of Kailua Bay, is the westernmost point of Hawaii. It is marked by Keahole light (group flashing white). The point is prominent, low, and well defined and consists of black lava. A shoal makes off the point for about $\frac{1}{4}$ mile.

Mount Waawaa, 5 miles northward of Mount Hualalai, is prominent, about 3,800 feet 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 500 feet above the slope on which it stands.

Kuili Hill, 5 miles northward of Keahole Point and $\frac{1}{4}$ mile inland is a brown crater, 346 feet high, which marks the seaward end of a series of blowholes that are on the ridge on the northwesterly slope of Mount Hualalai. Between Keahole Point and Kawaihae Bay there are several small bays, which are not used.

The coast between Kailua Bay and Kawaihae Bay is a black jagged mass of lava, with numerous capes and indentations 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.

Mahiula, about 4 miles north of Keahole Point, is on an unimportant bay off which there is reported shoal water for a distance of 1 mile. There is another extensive shoal extending $\frac{1}{2}$ mile offshore about 4 miles northeast from Mahiula.

Puako, 20 miles northeast from Keahole Point, is an abandoned sugar mill and buildings. There is a large flat area formerly under cultivation, but lack of water proved a detriment.

Kawaihae Bay, 22 miles northeastward of Keahole Point, is an open bight and is marked on its northerly side by Kawaihae (flashing white) Light. The bay affords good anchorage for vessels of any size, except during kona weather, about $\frac{3}{8}$ mile offshore, in 7 to 8 fathoms, with Kawaihae Light bearing anything eastward of 66° true (NE by E mag.). A reef about $\frac{1}{2}$ mile wide and bare in places fringes the beach in front of the village, and it should be approached with caution, as the sea generally does not break over it during offshore winds. The landing is alongside of a wharf with an open

shed on it in front of the village. The latter consists of a few houses scattered along the beach about $\frac{1}{4}$ mile southward of the light. Small boats anchor behind the reef just off the village.

PROMINENT FEATURES.—About 200 yards eastward of the light is a gray, one-story keeper's dwelling, with red roof. Between the light and dwelling is a white stone beacon and a wireless-telegraph mast. About $\frac{1}{2}$ mile northward of the village is the mouth of a deep gulch that divides into two branches near its head. The mouth of the gulch is thickly wooded, and 100 yards southeastward is a conspicuous white rock at the southeasterly edge of a dark bluff. About $\frac{3}{4}$ mile southward of the village is the foundation of the ancient temple of Kamehameha. It is a square of dark rock located on a low mound near the beach and is visible from the anchorage.

APPROACHING KAWAIHAE BAY FROM NORTHWARD, when within 2 miles of the beach head for Kawaihæ Light on a 89° true (E by N mag.) course and select anchorage as described in a preceding paragraph.

APPROACHING FROM SOUTHWARD, head for the mouth of the deep gorge $\frac{1}{2}$ mile northward of the village on a 55° true (NE mag.) course until Kawaihæ Light bears 89° true (E by N mag.). The local steamer makes regular calls here. This is a great shipping port for live stock.

Mahukona Anchorage is an open bight 10 miles northward of Kawaihæ Bay and is marked on its southerly side by Mahukona Light. On account of the fresh offshore winds in this vicinity vessels should anchor with plenty of chain and have a second anchor ready to let go. A current generally sets northward past the anchorage. The landing is in front of the village, alongside of a wharf with a house on it. There are several mooring buoys off the landing in 7 to 10 fathoms. **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.

Prominent features.—Mahukona range lights (fixed red), maintained by private parties, lead to the outer mooring buoys on a 77° true (ENE mag.) course. There are two conspicuous white conical towers, each 15 feet high, one on the southerly side of Makaohule Point and one about 400 yards southward of the boat landing between Mahukona Light and the beach. The oil tank and warehouses on the north side of the anchorage are prominent. There is a second derrick and landing on the north point close to the oil tank. This is used when more than one ship is in port or when the other landing is unsafe.

The local steamer calls regularly, as well as freighters.

ANCHORAGE can be found in 10 fathoms just northward of the outer mooring buoys, but in no case should vessels anchor southward of them, as the bottom is very foul. Vessels intending to moor to the buoys should use exceptionally strong lines and also be prepared to let both anchors go if necessary. An anchorage where the wind does not blow so strong can be found $\frac{1}{2}$ mile northward of the landing and about 400 yards off the railroad embankment. The local pilot will moor vessels if desired.

SUPPLIES.—Provisions, coal, and water can be obtained in limited quantities.

Honoipu Anchorage, 4 miles northward of Mahukona, is an open bight. Anchorage can be found in 8 to 10 fathoms, with the seaward end of the wharf bearing 78° true (ENE mag.) and the cable house bearing 122° true (ESE mag.). This landing has been abandoned in favor of Mahukona. 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.

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 follows 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 current strongest when the wind is between north-northeast and east-northeast.

MAUI,

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 consists of two distinct mountain masses joined by a low flat isthmus. The extinct crater of **Haleakala** 10,032 feet 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 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.

RIVERS.—There are numerous streams emptying into the sea, none of which are navigable except for small boats.

POPULATION.—By the census of 1920, Maui had 36,080 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 in 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 shore of Maui through **Alalakeiki Channel** around the northerly end of **Kahoolawe**, but is not felt on the westerly shore of that island. On the south coast of Maui a sea breeze sets in about 9 a. m. and continues until after sundown, when the land breeze then springs up. Light airs or calms are generally found in the vicinity of **Molokini**.

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, coal, fuel oil, and some ship chandler's stores can be obtained at Kahului. Some provisions can be obtained at other places.

REPAIRS.—There is a machine shop at Kahului where minor repairs can be made.

COMMUNICATION is frequent with Honolulu.

RAILROADS.—Railroads extend a short distance northeastward, southward, and northwestward from Kahului.

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

TELEPHONE.—There is communication by telephone to all parts of the island and by wireless telegraph to the other islands.

CURRENTS.—Generally the currents set with the trades. A current follows the north shore of Maui westward from Kauiki Head and draws down through Pailolo Channel; the current is stronger on the Molokai side of the channel. A strong current follows the coast southward of Kauiki Head until past Kahoolawe. It is said that a slight current sets southeastward in Alalakeiki Channel. In the vicinity of Lahaina the current generally sets northwestward.

Hana Bay (Pueokahi Bay) is situated at the easterly end of Maui Island and is marked on its southerly entrance point by a flashing white light. The bay is $\frac{3}{8}$ mile in diameter and may be picked up from offshore by identifying Kauiki Head which marks the south side of the bay. There is a concrete wharf on the south side of the bay, with depths of 20 to 28 feet alongside. The local steamer makes regular calls here. Sugar is the principal export. 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. A shoal extends almost halfway across the bay from the middle of the north shore. Except in calm weather it is marked by breakers. A more exposed anchorage for deeper draft vessels can be found in 9 to 10 fathoms about midway between Kauiki Head and Nanualele Point, with Outer Pinnacle Rock showing between Twin Rocks, bearing 151° true (SE $\frac{1}{2}$ S mag.), and the sugar mill, bearing 217° true (SSW $\frac{3}{8}$ W mag.).

Nanualele Point is the low, flat, lava point on the north side of Hana Bay.

Haula Cone, 540 feet high, is the highest of a group of five hills lying $\frac{1}{2}$ mile westward of the landing. The sugar mill and plantation buildings $\frac{1}{4}$ mile southwestward of the landing are conspicuous, in a large cane field.

Kauiki Head, the easternmost point of Maui, is an extinct crater, 392 feet 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 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 Kauiki Head light; the inner rock is 20 feet and the outer rock 14 feet high.

Inner Pinnacle Rock, about 3 feet high, lies 200 yards southward of Outer Twin Rock.

Outer Pinnacle Rock, about 5 feet high, lies 300 yards southeastward of Outer Twin Rock. A shoal about 250 yards in diameter and with 4 to 6 feet over it lies northward of the channel and about 400 yards northwestward of Kauiki Head Light. The land near the coast is covered with cane for a distance of about 4 miles on each side of the mill. 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, $1\frac{1}{2}$ miles southward of Kauiki Head and $\frac{3}{8}$ mile offshore, is about 100 yards in diameter and 150 feet high, and is grass covered. Between the island and the mainland there is an extensive reef. Two rocks, with about 6 feet over them, lie close together, about $\frac{3}{4}$ mile southeastward of the island. Vessels should give the island a berth of about $1\frac{1}{2}$ miles in passing.

Iwiopete, about $1\frac{1}{2}$ 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 Iwiopete, affords a landing for small boats in northeast weather. About 3 miles southward of Alau Island there is a white church and dwelling standing on a bluff about 150 feet high. Landings may be made during northeast trade-wind weather in almost any of the coves south of Mokae Cove.

Wailua Cove, about $3\frac{1}{2}$ 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.

Kipahulu, $2\frac{1}{2}$ miles southwest from Wailua Cove, is a plantation town, marked by a mill with two stacks and two churches with spires situated about $\frac{1}{2}$ mile apart. There are two landings on the shore below the town, but they are not used now, as all freight is transported to Hana by motor truck. **Ahole Rock** lies about $\frac{1}{4}$ 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 $1\frac{1}{2}$ 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 about 200 yards off the pebble beach.

Kaupo Landing, about $1\frac{1}{2}$ miles west of Kaapahu Bay, is the best landing place in the vicinity during trade-wind weather. The local steamer visits this place at two-month intervals, handling general cargo.

Kailio Point, about $2\frac{1}{2}$ miles southwest of Kaupo Landing, is a narrow point about 75 feet 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, sandy bottom.

Apole Point, $1\frac{3}{4}$ miles westward of Kailio Point, is low and is composed of black jagged rock.

Nuu Anchorage, about $2\frac{1}{4}$ miles westward of Kailio Point and immediately westward of Apole Point, is in the bight which lies northward of the first large lava flow westward of Kaupo Gap, and is marked by a white storehouse on the beach. Anchorage can be found in 8 fathoms, sandy bottom, with the white storehouse bearing 45° true (NE $\frac{7}{8}$ N mag.), distant about 400 yards. The local steamer calls at intervals of several months. Cattle is the principal export. From Nuu to **Pohakueaea Point**, $11\frac{1}{2}$ 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 curve begins to trend offshore.

Danger.—A pinnacle rock with less than 12 feet over it is said to exist somewhere between Pohakueaea Point and Keoneoio Bay, within $\frac{1}{2}$ mile of shore. It may be off Pohakueaea Point as an extension of the lava flow that forms the point.

Lualailua Mountains, 7 miles westward of Nuu Anchorage and 2 miles inland, are a group of red mounds about 2,000 feet 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, $2\frac{1}{4}$ 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 $\frac{1}{2}$ mile wide and indents the coast about $\frac{1}{2}$ 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 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 $4\frac{1}{2}$ feet over it lies 400 yards offshore near the northerly end of the cape.

Olai Hill, $2\frac{1}{4}$ miles northward of Kanahena Point, is the most prominent landmark in this vicinity. It is brown in color, 356 feet high, and consists of three knolls.

Molokini, marked by a light, lies $2\frac{1}{2}$ miles 263° true (WSW $\frac{1}{2}$ W mag.) of Olai Hill.

Makena Anchorage, 1 mile northward of Olai Hill, is exposed to kona weather, but affords good holding ground in 10 fathoms with the brownstone church bearing 123° true (ESE mag.) and the boat landing bearing 85° true (ENE $\frac{5}{8}$ E mag.). The boat landing is $\frac{1}{4}$ mile northward of the church, alongside of a shed on the southerly side of the most prominent point in the vicinity. There is a group of

houses back of the landing, southeastward of which is a thick algaroba grove. The country back of Makena rises gently to the mountains; the lower slopes are covered with cactus, while higher up it is thickly wooded. 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.

Keawakapu Anchorage, 4 miles north of Olai Hill, is marked by a large wharf extending offshore in a southwesterly direction.

Maalaea Bay is the large bight in the middle of the southwesterly coast of Maui; its shores are low and sandy and lined with algaroba trees. The isthmus and the slopes on either side are covered with sugar cane and other vegetation. 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 $3\frac{1}{2}$ miles southward of Kihei. Off Kalepolepo, where the reef is widest, there is a 14-foot spot at its outer end, lying $\frac{1}{2}$ mile from shore. Strangers should pass well offshore. Broken ground, with a least depth of 3 fathoms, lies about $\frac{3}{4}$ mile west-southwestward of Kihei wharf.

Kihei Anchorage, 9 miles northward of Olai Hill, is marked by a sugar mill and plantation settlement. There is a wharf near the mill. A white oil tank and a tall chimney are located north-northeastward from the wharf at a distance of $\frac{1}{8}$ and $\frac{3}{8}$ mile, respectively. Anchorage can be found in 5 fathoms near the mooring buoys about $\frac{1}{2}$ mile off the wharf.

McGregor Point, marked by a concrete structure of a former light, is on the westerly side of Maalaea Bay. There is a boat landing here. 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.

Olowalu Anchorage, 5 miles west-northwestward of McGregor Point, is marked by a mill, which is close to the beach near a clump of trees on a low point planted in sugar cane. There is a small wharf, for lighters, near the mill. Vessels can anchor close inshore off the mill, near the mooring buoy.

Launiupoko Point is about 2 miles northwest from Olowalu. An extensive shoal with a least depth of 5 feet lies approximately 800 yards off the point.

Lahaina Anchorage, 5 miles northwestward of Olowalu, is marked by a flashing red light. It is a good anchorage and is generally calm except during kona weather. Lahaina village is scattered along the beach among the trees. It is the distributing center for this part of the island. The boat landing is alongside of a wharf with a warehouse on it and close to the light tower. There is frequent communication with Honolulu by boat.

PROMINENT OBJECTS.—Lahaina Light is prominent 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. At the northwesterly end of the town, on Puunoa Point, is a tall black wireless-telegraph pole. Back of the town can be seen several tall stacks, which are on the sugar mills and pumping stations.

ANCHORAGE.—In approaching Lahaina vessels should keep about 1 mile offshore until the wharf or light bears 55° true (NE mag.) and then head in on this course until up to Lahaina buoy, then anchor in 10 to 12 fathoms.

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, which affords shelter for small boats during any kind of weather.

SUPPLIES.—Provisions, gasoline, and some ship chandlery can be obtained. Water can be obtained on the wharf.

The coast from Lahaina to Kekaa Point is low, back of which the country is planted in sugar cane.

Mala, about 1 mile northwest of Lahaina, is the location of a modern concrete wharf, 960 feet long. There is a depth of 32 feet at the end of the wharf. Along the north side, 300 feet from the end, this depth decreases to 24 feet, while on the south side, 250 feet from the end, there is a depth of 25 feet. Boats can not lie across the end of the wharf, as reinforcing rods are projecting several feet, to be used in a contemplated extension of the wharf. There is a tidal current that parallels the shore line at the end of the wharf with a force of $\frac{1}{2}$ to $\frac{3}{4}$ knots. At flood tide the current flows north, while ebb tide flows south. The principal freight handled at this wharf is that from the pineapple cannery at Mala. Anchorage can be had anywhere in the bay north of the wharf, $\frac{3}{4}$ mile offshore, in 8 to 10 fathoms, or $\frac{1}{2}$ mile off in 5 fathoms, sandy bottom. Mala gas buoy is located about 300 yards from the end of the wharf and in line with the north side of wharf, in a depth of 7 fathoms.

Kekaa Point, $3\frac{1}{2}$ miles northward of Lahaina, is the extreme western point of the island, and is a prominent landmark in the vicinity. The point is a dark rock, 75 feet high and 300 yards long, and from a distance looks like a detached rock. 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 numerous clumps of algaroba trees. So far as known, this section of the coast has no outlying dangers. The country slopes gently, is more or less cut up by shallow gulches, presents a brownish appearance, and is covered with short grass.

Kaanapali Landing, on the northerly side of Kekaa Point, is marked by a warehouse and a black oil tank, which are just inside the sand beach.

Kaanapali is the terminus of a plantation railroad which handles most of the sugar from this district. The boat landing is alongside of a wharf which has derricks on it. Off the end of the wharf are several mooring buoys. Good anchorage can be found in 10 to 20 fathoms about $\frac{1}{4}$ mile off the wharf in the vicinity of the mooring buoys. The local steamer calls here.

Napili Bay, $4\frac{1}{2}$ miles northward of Kekaa Point, is a small bight between two coral reefs, where an anchorage can be found about $\frac{1}{2}$ mile offshore in 5 fathoms. It is seldom used. Small boats can land here in trade wind weather.

Haweia Point, 5 miles northward of Kekaa Point, is marked by Haweia Point Light (flashing white).

Honolua Bay, about 1 mile northward of Napili Bay, is the open bight lying between Haweia Point and Lipoa Point. A fair anchorage can be found for small vessels southward of Lipoa Point. The boat landing is at the head of the bay, and is well protected from the northeast trades. 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 these rocks a berth of $\frac{1}{2}$ 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 Head Light (fixed white). There are several bare black rocks off the point.

Puu Koa (Sugarloaf), 3 miles east-southeastward of Nakalele Head Light, is a dark, bare, conical mound, 634 feet high, marking the seaward end of one of the numerous ridges that end abruptly at the sea. Close to Puu Koa and just eastward, on the end of the same ridge, is a low and more rounded dome. There is deep water close to Puu Koa. A rock awash lies in the cove between Puu Koa and Mokeehia.

Mokeehia Island, $1\frac{1}{2}$ miles southeastward of Puu Koa, is a large bare rock on the outer end of Hakuhee Point, and from a distance it looks like an island. Large caverns can be seen in the face of the cliffs on both sides of the rock. About 3 miles southeastward of Mokeehia Island is a reef that extends about $\frac{3}{4}$ mile offshore and is marked by Waihee Reef gas buoy, which is moored in a depth of 18 fathoms about 1 mile offshore. The country between Mokeehia Island and Pauwela Point, about 9 miles east-northeastward of Kahului, is covered with sugar cane.

Waihee Valley, $2\frac{1}{2}$ 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, about $6\frac{1}{4}$ miles southeastward of Mokeehia Rock, is an indentation between two coral reefs, and is about $\frac{1}{2}$ mile wide at its entrance, contracting to about $\frac{1}{4}$ mile at the anchorage, and is $\frac{3}{4}$ mile long. It is the leading commercial port of the island, and is frequented by both steam and sailing vessels. The harbor affords good anchorage at all times, except when the wind is from north to northwest, at which times a heavy swell sets in. The shores of the harbor are low and sandy. On the northeasterly side the harbor is protected by a breakwater which extends in a west-north-westerly direction out to American Girl Rock and has deep water near its end. There is a light on the breakwater at its outer end. A breakwater is under construction on the west side of the harbor.

Kahului is situated on the southeasterly shore of the bay, and is the distributing port for this section of the island.

WHARVES.—There is a depth of 21 feet alongside the railroad wharf. A new wharf is being constructed alongside the breakwater, and it is planned to have a depth dredged to 35 feet alongside both wharves.

PROMINENT FEATURES.—Three large white oil tanks on the easterly side of the harbor near the beach are conspicuous. Puunene mill, about $1\frac{1}{2}$ miles southeastward of Kahului, is conspicuous.

RANGE.—Kahului Harbor range lights are the guide to the anchorage on a $162^{\circ} 30'$ true (SSE $\frac{1}{2}$ E mag.) course.

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. The regular mail steamers from Honolulu will also do towing.

COMMUNICATION.—There is frequent communication with Honolulu by steamer.

HARBOR MASTER.—The harbor master designates the moorings and anchorages for the various vessels.

DANGERS.—A shoal, over which the sea usually breaks, extends about 700 yards from the western shore.

SUPPLIES.—Provisions, fresh water, and some ship chandlers' stores, as well as fuel-oil gasoline and distillate can be obtained.

REPAIRS.—There is a machine shop 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 $\frac{3}{4}$ 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 $3\frac{1}{4}$ miles northeastward of the breakwater at Kahului and $1\frac{1}{4}$ miles from shore. The coast between Kahului Harbor and Pauwela Point light is low, and the country back of it is covered with sugar cane.

Paia, 5 miles east of Kahului, is a plantation settlement, marked by several stacks on the sugar mills. There is an opening in the reef off Paia that is used by launches to enter an anchorage behind the reef. Local knowledge is necessary.

Maliko Cove, about $2\frac{1}{2}$ 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 form a natural breakwater. Anchor in 4 fathoms, rocky bottom.

Pauwela Point, 9 miles northeast of Kahului, is marked by a group flashing white light, and the lightkeeper's dwelling. 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. Eastward of Nahiku the bluffs become gradually lower, and when Kauiki Head is reached they are low. Sugar cane 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

between Pauwela Point and Huelo, a distance of 6 miles. 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, indenting the coast $\frac{1}{2}$ mile and having a distance of 1 mile between the points on either side, is a good anchorage in southerly winds for vessels. Anchor $\frac{1}{4}$ mile offshore in 12 to 16 fathoms, sand bottom.

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 a short distance off the beach.

Honopou Cove, 1 mile east of Pilale Cove, is an abandoned landing place. There is a stone wharf here. 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.

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.

Opuola Cove, $1\frac{1}{2}$ miles southeast of Hoalua Cove, is a narrow cove, having steep sides. Sometimes when the trades are blowing landings can be made here or an anchorage found for small boats and launches. Anchor in 3 to 6 fathoms near the center of the cove.

Keopuka Rock, $1\frac{1}{2}$ miles southeast of Opuola Cove, lies close to the shore. It is 141 feet high. Southwest of the rock is a small cove that furnishes a good anchorage for launches in trade wind weather. Anchor in from 3 to 5 fathoms 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. Anchor in 2 or 3 fathoms about 120 yards from the beach at the head of the bay. There is shoal water on the east side.

Keanae Point, 1 mile east of Honomanu Bay, is low and is marked on its westerly side by a stone church with a steeple. There are a few houses and clusters of trees on the end of the point. The landing is marked by a derrick. Small vessels can anchor in 8 fathoms close inshore immediately westward of the point. This anchorage should not be attempted without local knowledge, as there are some sunken rocks on the easterly side in the bight. The local steamer calls occasionally.

Keanae Valley, just eastward of Keanae Point, is the largest and most prominent valley on this part of the island. It leads inland toward the crater of Haleakala. Three high rocks close inshore form the most prominent landmarks 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.

Waikilo Anchorage is in 9 fathoms, sandy bottom, about midway between Pauwalu Point and the bight at Wailua and about 400 yards offshore. This is a fair anchorage when the wind is between south and southwest.

Aluea Rock lies about $\frac{1}{4}$ mile offshore and about the same distance southward of Waikilo Anchorage.

Nahiku Anchorage, $2\frac{1}{2}$ miles southeastward of Pauwalu Point, is in the open bight off Nahiku, in 7 fathoms, 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. The local steamer calls occasionally.

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, and should not be depended upon.

Molokini, lying in the middle of the northerly end of Alalakeiki Channel, is a small, barren, crescent-shaped, rocky island 160 feet high, with the opening northwestward. A reef makes off about 300 yards northward from the northwesterly end of the island. There is deep water close to the island. It is marked by a light.

KAHOOLAWE,

the eighth in size of the islands, lies 6 miles southwestward of the southwestery end of Maui. It is about 9 miles long and 6 miles wide. The island presents an even and unbroken appearance. **Mount Moaula**, a brown dome 1,450 feet high, near the easterly end of the island, is the highest point and the most prominent landmark. There are no streams or springs on the island. In general, the island presents a very desolate and barren appearance, and is of but little commercial importance. An attempt is being made to reclaim the island by reforestation. Some cattle are being raised. There are no outlying dangers except the shoal off its westerly point. The southerly side consists of a high table-land which terminates in a high bluff at the beach. From **Kealaikahiki Point**, the extreme westerly point of the island, for about 2 miles southeastward, the shore is low and flat. A shoal with a least depth of 1 fathom extends 1 mile westward of Kealaikahiki Point, and vessels should give the point a berth of at least $1\frac{1}{2}$ miles in rounding. An anchorage and landing can be found in **Smuggler Cove** about 1 mile southeastward of the point. The northwesterly coast consists of low bluffs, from which the land slopes gently upward. About 2 miles southwestward of the extreme northerly point of the island are a few buildings on the easterly side of a small cove. There is an anchorage and landing here for small craft. The easterly coast consists of very high bluffs, in some places rising straight up from the water's edge for several hundred feet. An indifferent anchorage for small craft can be found in the southerly part of **Kanapou Bay** near the middle of **Beck Cove** and about $\frac{1}{4}$ mile from its head in 6 to 7 fathoms.

Kealaikahiki (the way to Tahiti) Channel lies between Kahoolawe and Lanai and is about 15 miles wide. So far as known 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.

Anau 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 $\frac{1}{3}$ mile offshore northward of **Wahapuu Point**, Lanai, the channel is free from obstructions. During trade winds it is often calm in the channel.

LANAI,

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 Palawai**, 3,400 feet high, located in the southeasterly part of the island. The slopes on the easterly side of the mountain are steep and cut up by deep gulches, while those on the westerly side are more gradual, terminating in a rolling plain. On account of the scarcity of rain there is a very limited supply of water on the island. In general, the island presents a barren appearance. It was formally devoted entirely to stock raising, but now pineapples are being successfully grown. The census of 1920 gave Lanai a population of 185 inhabitants. From **Wahapu Point**, the easternmost point of Lanai, to **Kamaike Point**, about $3\frac{1}{2}$ miles southwest, the coast is low and sandy. A coral reef fringes the shore from 100 to 200 yards off the beach. At **Kamaike Point** low bluffs appear, gradually increasing in height until close to **Manele Bay**, where they reach a maximum of 410 feet, when they decrease again to **Manele Bay**, where a sand beach again appears.

Manele Bay, on the southerly side of the island, is marked on its westerly side by **Puupehe Rock**. The bay is about $\frac{1}{4}$ mile wide and indents the coast about $\frac{1}{4}$ mile and is used as an anchorage by small local steamers. There is a boat landing at the head of the bay. A cattle chute on the west side of the bay is used to load live stock directly aboard a vessel moored close to the rocks. The local steamer calls occasionally. Under certain conditions when the trade winds are blowing squalls will alternate from the head of the bay and from the northeast along the coast. 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. There are several detached bare rocks on both sides of the bay near shore.

Puupehe Rock is a high, bare, brown rock separated from the shore by a low sand spit. It is the most prominent landmark along this section of the coast. 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 are many rocks close to the shore, one 400 yards off the shore about 2 miles east of **Cape Kaea**. 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, sandy bottom. From **Cape Kaea** northward to **Kaena Point** the coast is a series of high, precipitous bluffs, in some places between 300 and 400 feet high.

Kaumalapu Harbor, about $3\frac{1}{2}$ miles northward of **Cape Kaea**, is a small bight at the mouth of the most prominent gulch in the vicinity, affording an indifferent anchorage for small coasting vessels.

Five Needles are about $5\frac{1}{2}$ miles northward of **Cape Kaea** and about the middle of the bight on the westerly side of the island. They are a group of detached pinnacle rocks about 120 feet high, lying close inshore just northward of **Honopu**. On account of the high bluffs behind them these rocks are difficult to see from offshore.

Kaena Point is low and rocky and hard to distinguish from the other points in the vicinity. It is said that a shoal extends about $\frac{1}{4}$ mile offshore in this vicinity. From Kaena Point eastward the bluffs along the coast gradually become lower and within a few miles are only a few feet high and show sand beaches here and there. Back of the low section of the beach there is generally a narrow low strip of land which rises gently to the table-land. A coral reef fringes the sandy shore along the north and east shores of the island, sometimes extending $\frac{1}{4}$ mile offshore. About 4 miles northeast of Kaena Point is a low rounding point that is the most northerly point of the island. Just east of the point is an opening in the reef about 150 yards wide that is a very good landing place for small boats. About 4 miles east of this opening is another that furnishes a good anchorage for small boats in 4 feet of water.

Kuahua Gulch, 10 miles east of Kaena Point, is a conspicuous gulch that extends to the shore. It is forked, and so can not be confused with the deep gulch $2\frac{1}{2}$ miles to the southeast of Kuahua Gulch.

Kehamoku, about $2\frac{1}{2}$ miles southeast of Kuahua Gulch, is a small settlement. There is an opening in the reef here, the entrance of which is marked by three iron pipes. There is a good landing place for small boats, and a good anchorage, with a depth of 4 feet, behind the reef south of the entrance.

Halepalaoa, $1\frac{1}{2}$ miles southeast of Kehamoku, is a settlement situated at an opening in the coral reef. There is a wharf here with about 3 feet of water at the end.

Pailolo Channel, between Maui and Molokai, is about $7\frac{1}{2}$ 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 $\frac{3}{4}$ mile wide which fringes the shore of Molokai. Kamalo Point Reef gas buoy marks the edge of the reef off the southeasterly point of Molokai.

Kalohi Channel lies between Lanai and Molokai and is about 8 miles wide. With the exception of a reef about $\frac{3}{4}$ mile wide, which fringes the shore of Molokai, the channel is free from dangers.

MOLOKAI,

the fifth in size of the islands, lies $7\frac{1}{2}$ 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 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 **Mount Nana**, 1,382 feet high. From seaward this part of the island presents a smooth and rolling appearance.

RIVERS.—There are numerous streams emptying into the sea at the easterly end of the island, none of which are navigable.

POPULATION.—By the census of 1920 Molokai had 1,784 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 $1\frac{1}{2}$ miles in rounding.

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

ANCHORAGE.—There are few anchorages, none of which are sheltered from all winds.

COMMUNICATION with Honolulu can be had by steamer and wireless telegraph, and supplies can be obtained from there.

CURRENTS.—The current sets westward along the entire northerly shore and about half the length of the southerly shore, where an easterly current may be expected. From Cape Halawa 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 between 1 and $1\frac{1}{4}$ miles 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. Pukoo, Kamalo, and Kaunakakai are the only harbors on this coast. Molokai is used principally for raising stock. Some pineapples are grown in the northeast portion. Plans are under way to reclaim the island and divide it up into farms.

Halawa Bay, at the northeasterly end of Molokai, is about $1\frac{1}{2}$ miles wide between Cape Halawa and Lamaloa Head and indents the coast about $\frac{3}{4}$ mile. There is no shelter from the trades, but an indifferent anchorage can be found in 5 fathoms about $\frac{1}{4}$ mile off the landing. The latter is located on the northerly side of the village. The shores of the bay are high, precipitous cliffs. 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. There are two high detached rocks near the southerly shore of the bay.

Lamaloa Head, marking the westerly entrance of Halawa Bay, is a precipitous cliff about 840 feet high.

Cape Halawa, the northeasterly point of Molokai, is a cliff about 300 feet high. The coast between Cape Halawa and Kaunakakai Harbor rises gently, is much cut up with gulches, and is quite bare, with the exception that it is thickly wooded near the upper part of the gulches and mountains.

Mokuhooniki is a small, yellow, bare, rocky island with perpendicular sides about 200 feet high, lying about 1 mile offshore and 2 miles southward of the northeasterly point of Molokai. **Kanaha Rock**, about 95 feet high, lies just southwestward of Mokuhooniki. There is good water in the passage between the rocks and Molokai, but strangers should not attempt it. About $2\frac{1}{2}$ miles south of Cape Halawa the coral reef begins and extends along shore almost continuously to the southwest and south. There is a cove here that affords a landing place, and two more coves about $3\frac{1}{2}$ miles south of Cape

Halawa, that are used as landing places for small boats. These latter two are named **Honoulimaloo** and **Honouliwai**.

Pauwalu Harbor is an indentation in the reef about 5 miles southwest of Cape Halawa.

Pukoo Harbor, $7\frac{3}{4}$ miles southwestward of Cape Halawa, is a pocket, 500 yards long, with a clear width of 150 yards at the entrance and somewhat wider inside, in the reef and open southeastward. The harbor is an anchorage for small craft only on account of the limited swinging room; depth of 3 to 4 fathoms can be carried well in the harbor. The harbor is smooth during the trades, although the wind sweeps across it with full force. Pukoo consists of a few houses on the lowland near the beach in front of a deep gorge which has steep sides. A steamer from Honolulu calls weekly. A private range and buoy are maintained to guide this steamer to the anchorage. The reef extends almost a mile offshore here.

Kalaeloa Harbor, 3 miles west of Pukoo Harbor, is reported to be deep at its inner end, but that there is a 7-foot bar at its mouth.

Kamalo Harbor, about 5 miles west-southwestward of Pukoo Harbor, is a pocket in the reef, open southward, consisting of two arms, each about $\frac{1}{2}$ mile long and 150 yards wide. The entrance depths are limited by a bar with depths of 9 to 12 feet over it, outside of which an anchorage can be found, but there is no shelter from the trade winds or sea. The entrance to the harbor is marked by Kamalo Point Reef gas buoy, which lies about $\frac{3}{8}$ mile southeastward of the bar. There is a wharf at the head of the easterly arm, with a depth of 6 feet at its end. A private buoy and two private beacons mark the edge of the reef on the easterly side. A gasoline schooner from Honolulu calls irregularly.

Kaunakakai Harbor, 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, and the local steamers using the harbor go to the wharf. The latter extends $\frac{1}{2}$ mile off from the village of Kaunakakai to the easterly side of the harbor. The harbor is reported to be shoaling, but 10 feet can be taken to the westerly side of the end of the wharf. **Kaunakakai** consists of a few houses showing through the algaroba trees near the mouth of the largest gulch in the vicinity. Some cattle are shipped. A tall wireless-telegraph pole stands about 200 yards eastward of the inshore end of the wharf; the latter is also prominent. A church west of the pole is very prominent. Gasoline and some provisions can be obtained here in limited quantities.

Approaching **Kaunakakai Harbor** from either direction keep well outside of the reef which fringes the coast to a distance of about 1 mile until off the entrance. Vessels can anchor temporarily just outside the entrance, in about 15 fathoms, but there is no shelter from the trade winds and sea; or steer 35° true (NNE $\frac{1}{4}$ E mag.) on the line of Kaunakakai range lights, and leave the buoys on the sides indicated by their color. Between Kaunakakai and Laau Point the country is bare and rocky and much cut up by small gulches. The beach is sandy, with an occasional algaroba grove here and there. There are no prominent landmarks or signs of habitation along this section of the coast.

Laau Point, the southwesterly point of Molokai, is comparatively low and is marked by a light. An extensive reef makes off shore for about $\frac{3}{8}$ mile, and vessels should give the point a berth of about 1 mile.

Penguin Bank, an extensive shelf, makes out from the western end of Molokai, in a general west-southwesterly direction for a distance of 26 miles from Laau Point. The bottom on the bank is fairly flat and consists of sand and coral, with soundings of 24 to 30 fathoms. There is a reported sounding of 7 fathoms, $17\frac{1}{2}$ miles westerly from Laau Point, but its existence has never been verified. Along its northern, western, and southern edges it drops off very abruptly into over 100 fathoms. 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 strong 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.

Ilio Point, the northwesterly point of Molokai, is a low peninsula about 1 mile long and $\frac{3}{4}$ mile wide and rounded at its outer end. 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. There are a few ports where the local steamer calls, but with this exception there is practically no traffic along this coast, and no reason for deep-draft vessels to stand close to shore.

Between Ilio Point and Makaanalua Peninsula the country has very little vegetation. Beginning at Ilio Point, the bluff gradually becomes lower, and within 5 miles entirely disappears. At this point a low, precipitous cliff 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 high, and continue to the northeast end of the island.

Makaanalua Peninsula, 16 miles eastward of Ilio Point, is marked by Molokai light. The peninsula is low and extends out about 2 miles northward from the face of a high, precipitous cliff. The leper settlement of **Kalaupapa** occupies the peninsula. There is deep water close to the peninsula, except on the westerly side, where a reef about $\frac{3}{4}$ mile long extends about $\frac{1}{4}$ mile offshore, just northward of the landing at Kalaupapa. An indifferent anchorage can be found in 12 fathoms just off the landing, with the church bearing 100° true (E mag.), but a permit must be obtained, unless on Government business.

Between Makaanalua 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.

Between Makaanalua Peninsula and Umelehi Point, 6 miles eastward of Molokai light, there are several detached rocks, some of which lie about $\frac{3}{4}$ mile offshore. There may be submerged rocks in this locality, and strangers are cautioned to keep well offshore.

Kalawao, on the east side of the Makaanalua Peninsula, is a leper settlement marked by large well-kept buildings.

Pelekunu Landing is on the westerly side of a deep gulch about $5\frac{3}{4}$ miles eastward of Molokai light. There is a small village here. Taro is raised here and the local steamer calls during the shipping season. There are numerous waterfalls on the face of the cliffs between Pelekunu and Wailau.

Wailau Landing is on the westerly side of Lepau Point, about 8 miles eastward of Molokai light. There are a few houses here, and the local steamer calls occasionally. About 5 miles westward of Cape Halawa is a deep gulch, in which can be seen a waterfall that starts from an elevation of about 2,000 feet, and in one place has a perpendicular fall of about 500 feet.

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 in this channel, but in general they are apt to follow the trade winds, and when they cease the current is apt to set eastward.

OAHU,

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 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 is it 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 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 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.

RIVERS.—There are numerous streams emptying into the sea, none of which are navigable except for small boats.

POPULATION.—By the census of 1920, Oahu had 123,496 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.

ANCHORAGES are numerous, except on the northeasterly and northwesterly sides, the first requirement under ordinary conditions being shelter from the trade winds.

SUPPLIES.—Provisions, water, ice, lumber, coal, fuel oil, and ship chandlers' stores can be obtained at Honolulu.

REPAIRS.—There are machine shops at Honolulu where extensive repairs can be made. There is a floating dry dock, with a dead-weight capacity of 4,500 tons, and divers may be obtained.

COMMUNICATION with the United States, British Columbia, Australia, and the Orient may be had by several regular lines of steamers. There is frequent communication by coasting steamers around the islands.

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.

TELEPHONE.—There is communication by telephone to all parts of Oahu, and by wireless telegraph to the other islands, United States, and the Orient. There is cable communication with San Francisco and also with Manila via Midway and Guam.

QUARANTINE.—National quarantine laws are enforced by officers of the United States Public Health Service.

MARINE HOSPITAL.—An assistant surgeon of the United States Public Health Service is stationed at Honolulu for the treatment of seamen.

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 $\frac{1}{2}$ 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.

Makapuu Head, the easternmost point of Oahu is a bold, barren, rocky headland, 642 feet high, on which is located Makapuu Point Lighthouse. 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 curve is about $\frac{3}{4}$ 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. 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 high, and is a prominent landmark for vessels approaching from eastward. A wireless pole marks the highest point. Between Koko Crater and Koko Head the coast is rocky and precipitous and somewhat irregular.

Hanauma Bay, just eastward of Koko Head, is about $\frac{1}{4}$ mile wide and indents the coast about $\frac{3}{8}$ mile. It affords good shelter for small craft, but during east-northeast or easterly winds it is very choppy off the entrance.

Koko Head, about 2 miles southwestward of Koko Crater, is a bold promontory 644 feet 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. There is deep water close to the point.

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 $\frac{3}{4}$ mile from the head of the bay, but there are two openings in the reef, where a small boat may pass to the beach, at the head. Outside of the 3-fathom curve the bottom is regular, and vessels can anchor anywhere in smooth weather. The shore of the bay is low and wooded.

Diamond Head, about 6 miles westward of Koko Head, is an extinct crater, 761 feet 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 above the water, which shows a broken bluff line to seaward. Between Diamond Head and Honolulu the coast is low and thickly wooded. Numerous houses can be seen along the beach, the most prominent of which is a large building close to Diamond Head and the Moana Hotel.

HONOLULU HARBOR

is the most important port in the Hawaiian Islands, and is the only commercial harbor affording protection in all weather. It lies 15 miles westward of Makapuu Head and 13 miles eastward of Barbers Point. The entrance through a coral reef is a channel $\frac{5}{8}$ mile long and 400 feet wide, and the harbor is $\frac{1}{2}$ mile long and 1,000 to 1,200 feet wide, and both have been dredged to a depth of 35 feet; in 1922 the

least depth in the channel was 35 feet. The channel is well marked by lights and buoys, and the harbor is easy of access for steamers both day and night. There are depths of between 20 and 35 feet alongside the principal wharves.

Honolulu is the capital of the islands. It is a city with all modern improvements, and in 1920, had 83,327 inhabitants. The city is located on the low plain that lies at the foot of the Koolau Range, about halfway between Makapuu Head and Barbers Point. There is a large foreign and coastwise trade here.

PROMINENT OBJECTS.—The most prominent object in Honolulu from offshore is the chimney on the Hawaiian electric plant, close to the east side of the harbor. It is 225 feet high. Honolulu Harbor lighthouse and the Quarantine station with a white flagpole are on the westerly side of the harbor. The crematory chimney is on the easterly side of the harbor. Punchbowl is a flat-topped, conical hill, about 500 feet high, lying immediately back of the city. Mount Tantalus, about 2½ miles northeastward of Punchbowl, is a rounded peak about 2,000 feet high and is heavily wooded at its summit. Mount Konahuanui, about 2 miles northeastward of Mount Tantalus, is 3,105 feet 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 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 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, 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.

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.

MARINE HOSPITAL.—There is a commissioned officer of the Public Health Service at Honolulu, to whom application can be made for relief, the office being in the customhouse.

SUPPLIES.—Coal and fuel oil can be obtained. Water can be obtained alongside the wharves or from water boats. Provisions and ship chandlers' stores are to be had in the city.

REPAIRS.—There is a floating dry dock with a dead-weight capacity of 4,500 tons. There are machine shops and shipyards where extensive repairs can be made. Divers can be obtained.

TIME SERVICE.—Vessels can obtain chronometer comparisons and geographical information relative to the islands at the Government survey office. (See page 4 for time signals by radio.)

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. The following directions lead in a least depth of about 35 feet:

From eastward, passing $1\frac{1}{2}$ miles or more south-southeastward and 1 mile or more south-southwestward of Diamond Head Lighthouse, steer for Mount Kaala, the highest peak of the Waianae Mountains, on a $309^{\circ} 30'$ true (NW by W $\frac{3}{8}$ W mag.) course for about 4 miles until off the entrance of the harbor. Then steer $29\frac{1}{2}^{\circ}$ true (N by E $\frac{3}{4}$ E mag.), with Honolulu Channel range lights ahead, and pass between the buoys and lights that mark the sides of the channel. When inside of Honolulu Harbor Lighthouse, haul northward, passing along the wharves.

From westward, passing $1\frac{1}{2}$ miles or more southward of Barbers Point, vessels can at night steer for Diamond Head Lighthouse on any bearing northward of 93° true (E $\frac{5}{8}$ N mag.), or in the daytime steer on any bearing northward of $87^{\circ} 30'$ true (ENE $\frac{7}{8}$ E mag.) for Koko Crater. 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.

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 sugar cane; 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 $1\frac{1}{2}$ miles westward of Honolulu, is a narrow channel through the reef, used only by boats and launches.

Barbers Point is a low, flat coral plain covered with algaroba trees and is marked by Barbers Point Lighthouse. The coast curves gradually and shows a white, sandy beach with here and there dark rocks. 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. From Barbers Point to Kaena Point, a distance of about $19\frac{1}{2}$ 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 $1\frac{1}{2}$ 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 $\frac{1}{2}$ and $\frac{3}{4}$ mile wide fringes the coast from Barbers Point to Kahe Point.

Kahe Point, $3\frac{1}{2}$ miles northwestward of Barbers Point, is the seaward end of a mountain spur.

Puuhulu Ridge, $3\frac{1}{2}$ miles northwestward of Kahe Point, is a narrow, rocky, barren ridge, $1\frac{1}{2}$ 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, and is precipitous on its seaward side.

Maililii Hill, about 2 miles northward of Puuhulu Hill, is a narrow, rocky ridge 729 feet 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.

Pokai Bay, about 1 mile northwestward of Maililii 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 a mill stack is prominent from offshore. **Waianae** is on the railroad and there is practically no shipping by water. Landing can generally be made except during southerly winds. In entering Pokai Bay, vessels should head for the mill stack at **Waianae** on an 80° true (ENE $\frac{1}{8}$ E mag.) course, and anchor about $\frac{1}{2}$ mile offshore in 8 to 10 fathoms.

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 Maililii Hill divides the valley in two.

Lahilahi Point, $1\frac{1}{2}$ miles northwestward of **Waianae**, is a detached, steep ridge of dark rock 234 feet high, which forms a narrow point projecting about $\frac{1}{4}$ mile.

Kepuhi Point, about $1\frac{1}{8}$ 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.

Makua village, 3 miles northward of **Kepuhi Point**, is at the head of the first bight below **Kaena Point**. The red church spire, beside which is a white house, shows well from seaward. Two or three other houses and a windmill or two can also be seen. Back of the village is a small crater-shaped valley. There is a sand beach at the head of the bay, where boats can land when there is little swell. Vessels can anchor within $\frac{1}{4}$ mile of shore in 4 to 6 fathoms. Between **Makua village** and **Kaena Point** the coast is rocky, except for one short sand beach, and the mountains rise steeply from the beach.

Kaena Point, the westernmost point of Oahu, is a low, rocky point extending out a few hundreds yard from the foot of **Kuaokala Ridge**, and is marked by a flashing white light. 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 $\frac{1}{4}$ mile.

Kuaokala Ridge is high and its seaward end breaks off rather abruptly. From **Kaena Point** to **Kahuku Point**, a distance of about $18\frac{1}{2}$ 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 $6\frac{1}{2}$ miles eastward of Kaena Point and $\frac{1}{2}$ mile off the village of Mokuleia there is a rock awash. The breaker or the rock itself is always visible.

Kaiaka Bay, 9 miles eastward of Kaena Point, is a small indentation in the coast.

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. Its shores consist of low, black rock, with sand patches in the bights.

PROMINENT OBJECTS in the vicinity of Waialua are the church spire, the two flagstuffs on the Haleiwa Hotel, the roof only of which shows above the trees, and a large black chimney, with a mill beside it. There is a small islet on the northerly side of the bay, but it is not easily identified from offshore. About 1 mile northeastward of Waialua Bay and $\frac{3}{8}$ mile inland is a pumping station with two large smokestacks. Back of the pumping station, on the brow of the hill, is a grove of trees and a plantation settlement. Between Waialua and Kahuku Point there is a narrow strip of low land along the coast, back of which is a table-land covered with vegetation, with steep grassy slopes facing the sea. These slopes are cut up in places by deep gorges.

Waimea Bay, $3\frac{1}{2}$ 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 railroad bridge can be seen across the stream that flows down the gorge. There are several scattered buildings on the northerly side of the bay. The beach at the head of the bay is sandy, but on both sides of the entrance it consists of low, rocky ledges. Off the southerly entrance point are two ragged masses of black rock, with deep water close to on the off-shore side. Near the northerly entrance point are some submerged rocks, which are generally marked by breakers. Vessels can stand in for the middle of the bay and anchor about $\frac{1}{4}$ mile offshore in 9 to 10 fathoms, sandy bottom, with the mouth of the river bearing 101° true (E mag.). About $3\frac{1}{2}$ miles northeastward of Waimea Bay and $\frac{1}{4}$ mile inland is the Waialeale industrial school, a group of prominent buildings. About $1\frac{1}{4}$ miles northeastward of the Waialeale industrial school and $\frac{1}{2}$ mile inland is a prominent smokestack standing at the end of a high flume.

Kahuku Point, the northernmost point of Oahu, is low, covered with sand dunes partly covered with vegetation, and has a few scattered palms. The coast rounds gradually at this point, and there are a number of small black rocks close inshore. The land rises gently from the bluffs at the point to the mountains. Off this point the 10-fathom curve draws in to about $\frac{3}{8}$ 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. 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. A wagon road and railroad parallel the coast, and numerous villages can be seen from offshore.

PROMINENT OBJECTS along the coast are: A tall black stack about 1 mile southward of the extreme northerly end of the island; several wireless-telegraph poles near the beach, about 2 miles northwestward of Laie Bay; a large black stack about $\frac{3}{8}$ mile southwestward of the wireless pole; the Mormon Church at Laie Bay; two church spires near the beach, about $\frac{1}{8}$ mile apart and about 2 miles northwestward of Kahana Bay; and two schoolhouses, with flagpoles, standing close together near the beach, about $1\frac{1}{4}$ miles southeastward of Kahana Bay.

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, 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 being the largest. The entrance of the bay is near the south side of the middle islet on a 214° true (SSW $\frac{1}{8}$ W mag.) course for the Mormon Church (large and prominent, with cupola). Strangers should not attempt to enter without a pilot.

Laie Point is low, and has a rocky beach. Off its end are two small, flat, rocky islets.

Kahana Bay, $6\frac{1}{2}$ 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.

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 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 through the former and 8 feet through the latter. In heavy trades the sea breaks across both entrances. Strangers should not attempt to enter without a pilot.

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. **Ulupau Head**, at the northeasterly end of the peninsula, is a rocky headland, part of the rim of an old crater. **Mokumanu Islands**, lying $\frac{3}{4}$ mile northward of the head, are two small islands, about 200 feet high, with vertical sides. The passage southward of the islands has a depth of about 5 fathoms 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. 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 high, with 5 to 8 fathoms around it.

Mokulua Islands, the northerly one 206 feet high and the southerly one 182 feet high, are steep, rocky islets with grass-covered slopes, lying about $\frac{3}{4}$ mile offshore and midway between Alala and Wailea Points.

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 over the bar and 10 feet inside. During strong trades the entrance is closed by breakers. There is a small wharf in the southerly part of the bay. The small craft calling here lie off its end and lighter their cargo. There is a shallow boat passage along the beach between Waimanalo Bay and Kailua Bay.

Manana Island, 359 feet 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 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 high, lying about midway between Manana Island and Makapuu Head. A double rock about 10 feet 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 between Manana and Kaohikaipu Islands, but owing to the reefs which make off from both islands, strangers should not attempt it. There is 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.

the fourth in size of the islands, lies 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 about 5,170 feet. 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.

RIVERS.—There are numerous streams emptying into the sea, none of which are navigable except for small boats.

POPULATION.—By the census of 1920, Kauai had a population of 29,247 inhabitants.

WINDS.—The trade winds divide on the easterly side of Kauai, part following the northerly and part the southerly coasts, uniting again on the westerly side of the island.

RAINFALL.—The weather side of the island is noted for its frequent heavy rainfalls, with a fall of less than 20 inches a year along the southerly side.

ANCHORAGES are numerous, but none of them afford shelter in all weather for large vessels.

SUPPLIES.—No supplies of any kind can be obtained, except some provisions in case of necessity.

COMMUNICATION with Honolulu is frequent. Vessels of the Matson Navigation Co. call to load sugar.

HIGHWAYS.—There are good highways in many parts of the island, and transportation can be obtained at most of the towns.

TELEPHONE.—There is telephone communication to all parts of the island, and by wireless telegraph to Honolulu.

CURRENTS.—The currents are said by many of the best interisland navigators to be very uncertain as to direction, but they generally follow the winds, though frequently setting in the opposite direction during the first calms after strong trades.

Nawiliwili Bay, at the southeast end of Kauai, is about $\frac{3}{4}$ mile wide between Ninini Point and Carter Point and indents the coast about $\frac{7}{8}$ mile. The shore is rocky bluffs, except at the mouth of Huleia River and in the northwesterly part near the landing at Nawiliwili village. The inner part of the bay is obstructed by reefs, but with local knowledge small steamers enter to discharge or load. The anchorage used by these steamers is just inside Kukii Point. In the absence of local knowledge the inner harbor should not be attempted by anything but small craft. An anchorage for deeper-draft vessels can be found anywhere in the bight between Ninini and Kukii Points. A reef with depths of less than 1 fathom in places extends about $\frac{3}{8}$ mile northward from Mokole (Carter) Point. A breakwater is being constructed on this reef, extending from the south shore. There is frequent communication with Honolulu. Passengers and cargo are transported between the vessel and the wharf, in the northwest corner of the bay, at which there is a depth of 4 feet, in small boats.

Ninini Point is low and flat, marked at its east end by Nawiliwili Harbor light.

Kukii Point, $\frac{3}{4}$ mile westward of Ninini Point, is a high bluff with deep water close-to, and is marked by a light.

Huleia River, at the southwesterly end of the bay, is navigable several miles for boats.

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

Kawai Point, $\frac{1}{2}$ mile southward of Mokole Point, is a bold, rocky headland 525 feet high. It is very irregular and jagged in appearance.

Kaweliko Point, 3 miles southwestward of Kawai Point, is a dark, rocky, headland, 687 feet 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 extends well up the mountains.

Makahuena Point, the south end of Kauai, is low, flat, and sandy, with a rocky shoreline, and is marked by a flashing white light. The land in this vicinity is low and rolling. A reef is said to extend about $\frac{1}{2}$ mile off the point.

Koloa Bay, $1\frac{1}{2}$ miles westward of Makahuena Point, is marked by a small warehouse, which stands on the bluff just above the landing. It is a small indentation affording fair protection in trade weather. At night a fixed red light, maintained by private parties, is shown from a pole in front of the warehouse. A narrow reef fringes the shore, just outside of which the small local steamers anchor. Anchorage, with good holding ground, can be found in 10 fathoms about 300 yards off the landing. Between Koloa and Hanapepe Bays there are several small bays in which small craft can find shelter during trade weather.

Makaokahai (Hinalua) Point, about $3\frac{1}{4}$ miles westward of Koloa Bay, may be recognized by several hills close to the beach.

Lanipua Rock, with 3 feet over it, and marked by a red nun buoy, lies $4\frac{1}{4}$ miles westward of Makahuena Point and $\frac{3}{8}$ mile southeastward of Hinalua Point. Vessels should not attempt to pass northward of the buoy.

Hanapepe Bay, 8 miles westward of Makahuena Point, is about $\frac{1}{2}$ mile wide and indents the coast $\frac{3}{8}$ mile. It affords shelter during the trades, with good holding ground. The shores of the bay are low, rocky bluffs, except at its head, where it is sandy. **Eleele Landing**, locally known as Port Allen, is on the easterly side of the bay just inside the breakwater, which is built out about 100 yards from the easterly point at the entrance. At the inshore end of the breakwater is a warehouse, one large and three small oil tanks, and a tall flagpole. A fixed red light, maintained by private parties, is shown from a mast surmounting a tripod near the inshore end of the breakwater. There are several mooring buoys southwestward of the breakwater. The local pilot will moor vessels. Small vessels can anchor 150 to 300 yards from the end of the breakwater, bearing 112° true (E by S mag.), in a depth of about 22 feet. The Matson Navigation Co. steamers call here to load sugar. Limited quantities of fuel oil may be obtained. Fresh water can be boated aboard, and ice can be obtained in any quantity on 24 hours' notice.

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.

Ukula Point, forming the westerly side of Hanapepe Bay, is low and flat and is marked at its easterly end by Hanapepe Light, with red sector covering Lanipua Rock.

Makaweli mill, painted red and with a red stack, is about halfway between Ukula Point and Makaweli Landing and about $\frac{3}{8}$ mile inland. It is prominent and at night is lighted by electricity. A ledge is reported to extend $\frac{3}{4}$ mile offshore between Makaweli mill and Makaweli Landing.

Makaweli Landing, about $4\frac{1}{2}$ miles northwestward of Hanapepe Bay, is a wharf built in a small bight. The current generally sets northward and westward in this vicinity. Sugar is shipped from here.

Makaweli Reef extends offshore about 1 mile between the point $\frac{5}{8}$ mile westward of Makaweli Landing and the easterly point at the entrance of Waimea Bay. It is marked off its end by a buoy (nun, red), and vessels should not attempt to pass inside it.

Waimea Bay, $1\frac{1}{4}$ miles northwestward of Makaweli Landing, is an open bight affording good anchorage in 3 to 9 fathoms in all but kona weather. The beach is sandy, back of which there is a narrow strip of lowland. The village is built in a coconut grove. A mill stack is a prominent mark. There is a substantial wharf. The local steamer calls here and anchors off the wharf in deep water, supplies and passengers being landed in small boats. A shoal about $\frac{1}{4}$ mile wide and with depths of 6 to 14 feet fringes the shores of the bay. **Waimea River** empties into the Bay on the easterly side of the town. It comes down from the mountains through the deepest gorge on this part of the island. Small vessels can anchor in 3 fathoms with the end of the wharf bearing 356° true (N by W $\frac{1}{4}$ W mag.), distance about $\frac{1}{4}$ mile. Provisions in limited quantities and fresh water can be obtained. A low, flat plain, about 2 miles wide, extends westward from Waimea Bay around the western end of the island to a point about 4 miles southward of Alapii Point. Along the seaward edge of this plain may be seen algaroba trees, behind which are several high sand dunes. Sugar is grown as far west and north as Nohili Point.

Kekaha, $2\frac{1}{2}$ miles west of Waimea, is a plantation settlement marked by a large gray stack on the mill.

Kokole Point, 5 miles west-northwestward of Waimea Bay, is low and rounded and is marked by a flashing white light. The coast between Alapii and Kailiu Points consists of a series of precipitous cliffs known as Napali. These cliffs are 2,000 feet high in places, are much cut up, and numerous streams can be seen forming small waterfalls. The southerly half of this section of the coast is practically bare, while the northerly half is wooded.

Kailiu Point, the extreme northwesterly point of Kauai, is the seaward end of a jagged ridge, which ends abruptly in a sharp peak about 150 feet high. There is a narrow strip of lowland at the point.

Haena Point, $1\frac{1}{8}$ miles eastward of Kailiu Point, is low and rounding. About $\frac{1}{4}$ mile southward of the point is a small white church with spire.

Wainiha Bay, $1\frac{1}{4}$ miles eastward of Haena Point, is an open bight in the mouth of a deep valley affording no protection except during easterly trades and kona weather. There are reefs in the bay, the positions of which can not be given, as no survey has been made.

Kolokolo Point, marking the easterly entrance to Wainiha Bay, is low. **Lumahai River** is just eastward of the point.

Makahoa Point is a black, rocky point on the west side at the entrance to Hanalei Bay. Back of the point is a high, green hill.

Hanalei Bay, about 1 mile eastward of Wainiha Bay, is about 1 mile wide between Makahoa Point and Puupoa Point and indents the coast about the same distance. A coral reef about $\frac{1}{4}$ mile wide, over which the sea generally breaks, fringes the shore on both sides. The beach at the head of the bay is sandy. Enter midway between the two entrance points on a 157° true (SE by S mag.) course and anchor in 6 fathoms, sandy bottom, about $\frac{1}{2}$ mile from shore. During northerly or northwesterly gales the sea breaks across the entrance of the bay. **Hanalei River** empties into the bay about $\frac{1}{2}$ mile inside the easterly entrance point, and is navigable for boats of shallow draft for a distance of 1 mile. There is a wharf with 6 feet of water at the end, about 700 feet west of the mouth of the river. The local steamer calls weekly. Rice is grown in the valley and is the principal export. **Waioli River** empties into the westerly part of the bay, but its mouth is generally closed by a bar. The village is scattered along the beach, behind which the mountains rise to an elevation of about 4,000 feet, and on account of the frequent rains are covered with vegetation. The land between Kailiu Point and Hanalei Bay is used chiefly for the cultivation of rice.

Puupoa Point, on the easterly side of the entrance to Hanalei Bay, is a bluff about 50 feet high, back of which a green ridge makes inland. From offshore the northerly side of Kauai presents a very irregular and jagged sky line, 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 and is used chiefly for grazing.

Kalihiwai Bay, about 5 miles eastward of Hanalei Bay, is marked on its easterly side by **Pukamoe Point**, a red, precipitous bluff about 150 feet high. The bay is about $\frac{1}{2}$ 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 near the head of the bay, but during northerly winds a heavy swell sets in.

Kilauea Point, about $1\frac{1}{2}$ miles eastward of Kalihiwai Bay, is a high bluff, and is marked by **Mokuaeae Island**, a black rock about 100 feet high, which lies about 200 yards offshore, and **Kilauea Point Lighthouse**, from which is exhibited a group flashing white light. **Kilauea sugar mill** lies about $1\frac{1}{4}$ miles southward of Kilauea Point. It can not be seen when close inshore. Between Kilauea Point and **Mokolea Point**, which lies about $1\frac{1}{4}$ miles southeastward, the coast is bluff, rising gradually from each point to an elevation of about 500 feet about midway between them. A black rock about 150 feet high lies close to shore just eastward of the highest point of the bluff. Sugar is grown between Kilauea Point and **Moloaa Bay**.

Mokolea Point is a high, sharp point, near the seaward end of which are two red houses and a derrick for handling freight.

Kilauea Bay is an open bight just eastward of Mokolea Point. The local steamers load sugar here by means of a wire cable. **Kilauea River** empties into the westerly part of the bay.

Kapuhi Point is a low, narrow point about $1\frac{7}{8}$ miles eastward of Mokolea Point.

Moloaa Bay, about $1\frac{1}{2}$ miles southeastward of Kapuhi Point, is a small open bay about $\frac{1}{4}$ 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 $1\frac{1}{2}$ 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, $1\frac{5}{8}$ miles south-southeastward of Moloaa Bay, is marked on its southerly side by Kahala Point Light. It is a small bight exposed to the trades, and on account of numerous reefs should not be attempted by strangers. **Konanae Hill**, about $1\frac{1}{4}$ miles westward of Anahola Bay, is the most prominent mountain peak in this part of the island. It is about 1,430 feet high and marks the seaward end of a range of conspicuous peaks which extend 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. The country south of here is planted in sugar cane.

Off **Kuaehu Point**, the northerly point of Anahola Bay, the water is discolored for a distance of about $1\frac{1}{2}$ miles offshore, and until the locality is surveyed it is recommended that vessels give the point a berth of over 2 miles.

Kealia Anchorage, about 3 miles southward of Kahala Point, is marked by a breakwater which extends about 600 feet offshore in a southeasterly direction. The boat landing is on the southwesterly side of the breakwater. The local steamers calling here find an indifferent anchorage, and vessels without local knowledge should not attempt it. About $\frac{1}{4}$ mile westward of the anchorage is a sugar mill and plantation settlement.

Kapaa, $1\frac{1}{4}$ miles southward of Kealia Anchorage, is a large village scattered along the beach. The northerly end of the village is marked by a tall, gray brick chimney.

Wailua is a small village $2\frac{1}{2}$ miles southwestward of Kapaa village. It consists of a few houses located on both sides of the mouth of the Wailua River, a little distance back from the sand beach. The river is navigable for boats for several miles after passing the bar.

Hanamaulu Bay, 3 miles southward of Wailua, is marked on its southerly entrance point by a red light, maintained by private parties, shown from a small wooden tower. The bay is about $\frac{1}{4}$ mile wide and indents the coast about $\frac{1}{2}$ mile, but the greater part of it is shoal. It affords good protection for small vessels, except during northeasterly winds, when a heavy sea sets into the entrance. There is a wharf just inside the southerly entrance point, and a depth of 24 feet can be taken to its end. This is the only wharf on the island to which the steamers make fast at present. A breakwater extends 100 yards from the southerly point. The local pilot and harbor-master should be consulted before entering. The mill on the north side of the gorge is prominent and at night makes a good mark, as it is well lighted. Sugar and pineapples are the principal exports. To enter, pass northward of the can buoys marking the shoal extending

northward of the southern entrance point. Round the north end of the breakwater and anchor in the vicinity of the mooring buoys which lie off the wharf.

About 1 mile westward of Hanamaulu Bay is **Kalepa Peak**, about 700 feet high, the southerly end of a low range of reddish-brown hills, which parallel the coast northward for a distance of about 4 miles. **Nonou Peak**, about 1,240 feet high, is near the northerly end, and is the highest and most prominent peak of the range. Just southward of Kalepa Peak is a large white sugar mill and plantation settlement. At night the electric lights of this mill are often seen before Nawiliwili Light is sighted. Between Anahola Bay and Nawiliwili Bay the coast consists of a series of low bluffs cut up by gulches, with here and there stretches of sand beaches. The land back of this section of the coast is used for the cultivation of sugar cane.

Kaulakahi, formerly called **Kumukahi** or **Niihau Channel**, lies between Kauai and Niihau, and is about $14\frac{1}{2}$ 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 sometimes 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,

the seventh in size of the islands, is at the westerly end of the group. It is about 16 miles long in a northeasterly direction and varies in width from about 3 to 5 miles. The island is low at both ends, but near the middle part of it there is a high table-land, with low projecting peaks, near the northerly end of which there is an elevation of about 1,300 feet. The northerly and easterly ends of the table-land are precipitous, varying in height from 600 to 1,000 feet, while the southerly and westerly slopes are more gradual. There are no streams on the island. The island is entirely devoted to stock raising. The census of 1920 gave Niihau a population of 191 inhabitants.

Lehua Island, about $\frac{1}{2}$ 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 738 feet near the center of the island. On the westerly point of the island there is a natural arch. Foul ground extends well north and east of the island. The channel between Niihau and Lehua is restricted on its southerly side by rocks showing above water, which extend about halfway across it. Vessels with local knowledge can find a channel with good water close to the southerly and southeasterly shore of Lehua. The northerly coast of Niihau is low, and off Kikepa Point there are several black rocks showing above water. Between this coast and the high precipitous bluffs marking the northerly side of the table-land the land is low. From Kikepa Point to Oku Point, a distance of about $1\frac{3}{4}$ miles, the coast is low and has a general southeasterly trend.

Kaunopou Rocks, showing above water, lie close to shore $\frac{1}{4}$ mile southward of Oku Point. From Kaunopou Rocks the coast trends westward for about $\frac{1}{2}$ mile to **Kii Anchorage**, where the local steamers anchor in about 5 fathoms, except during southerly or southeasterly weather. From Kii Anchorage to Pueo Point, a distance of about 5 miles, the coast has a general southerly trend. From Kii Anchorage southward for 2 miles the coast is low and sandy, and thence to Pueo Point it consists of high, precipitous bluffs. The entire easterly coast is practically free of outlying dangers, and by giving it a berth of 1 mile all dangers will be avoided.

Pueo Point is a prominent, brown, precipitous bluff about 800 feet high. From Pueo Point southwestward the high, precipitous bluffs are a feature of the coast for about $4\frac{1}{2}$ miles, when they then turn inland; thence to Cape Kawaihoa the bluffs along the shore are much lower.

Cape Kawaihoa, the southeasternmost point of Niihau, is formed by a hill about 600 feet high, which is precipitous on its seaward face. There is deep water close to the cape. Between the table-land heretofore mentioned and the southerly end of the island the country is a low, rolling plain, near the center of which is **Kawaewae**, a prominent, low, rounded, brown hill, with a flat top. From Cape Kawaihoa the coast gradually curves westward and northward. It is low and rocky, with sand beaches in places.

Kamalino is a small village located on a small bight about $4\frac{1}{2}$ miles northwestward of Cape Kawaihoa. From Kamalino to a point abreast of Lehua Island the coast is low, and is practically one continuous sand beach, with an occasional clump of black rocks. Near the beach are numerous sand dunes covered with vegetation. The country back of the coast is low, with small groves of trees in places. There are no harbors, although it is probable that an anchorage can be found almost anywhere during the trade winds.

Nonopapa Anchorage, 2 miles northward of Kamalino, is marked by a low, brown shed standing close to shore at the northerly end of a long sand beach. On the beach, immediately in front of shed, is a derrick. The prominent brown hill (**Kawaewae**), heretofore mentioned, lies about $1\frac{1}{2}$ miles 135° true (SE $\frac{7}{8}$ E mag.) of the anchorage. When making for an anchorage, bring **Kaeo Cone** in range with the shed on the bearing 70° true (NE by E $\frac{3}{8}$ E mag.) and stand in until in the desired depth. **Kaeo Cone** is a low cone near the center of the tableland, and on this bearing appears to be the highest point. At times a heavy swell makes landing very dangerous. About $1\frac{1}{4}$ miles northward of the landing of Nonopapa and $\frac{1}{4}$ mile inland a large dwelling with outhouses is located on a hill in a grove of trees. A reef, over which the sea generally breaks, extends about $\frac{1}{2}$ mile offshore at a point about $1\frac{1}{2}$ miles northward of Nonopapa. A black rock shows above water at the outer end of the reef, but vessels are cautioned to give it a berth of at least $\frac{1}{4}$ mile.

Dangers.—A shoal, which breaks only in a heavy sea, is reported to lie about $6\frac{1}{2}$ miles 236° true (SW $\frac{1}{8}$ W mag.) of Lehua Island. Between this island and the shoal there is much foul ground, and strangers are cautioned to give this locality a wide berth.

Kaula, about 19 miles southwestward of Niihau, is a small, bare, rocky islet about 500 feet high. A rock with a least depth of 39 feet lies about $3\frac{1}{2}$ miles northwest of Kaula. Three pinnacle rocks with depths of 30 feet over them are reported to lie about 4 miles west of Kaula.

NIHOA OR MODU MANU (BIRD ISLAND)

is a barren, rocky island lying about 140 miles $296^{\circ} 30'$ true (WNW $\frac{5}{8}$ W mag.) of the westerly end of Kauai, in latitude $23^{\circ} 05' 50''$ N, longitude $161^{\circ} 58' 17''$ W. The island is about $\frac{3}{4}$ mile long and averages a little more than $\frac{1}{4}$ 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 903 feet high. The peak near the northeasterly end is 869 feet high. The best anchorage can be found in Adams Bay, on the southerly side of the island, about 450 or 500 yards offshore. The bay consists of three small bights, the westerly one having a sand beach and the other two are rocky. The best landing is in the middle bight. However, it should not be attempted except in smooth weather. The island is uninhabited, and no water can be obtained. Nihoa is near the southwest end of a bank which is about 20 miles long and about 11 miles wide, with depths of 20 to 40 fathoms. Another bank, with depths of 20 to 30 fathoms, lies 3 miles west-southwestward. This bank is about 16 miles long and 10 miles wide. The edges of these banks break down steeply to great depths.

A sounding of 24 fathoms has been obtained in latitude $22^{\circ} 35'$ N, longitude $161^{\circ} 07'$ W, about 60 miles 122° true from Nihoa. There are depths of 20 fathoms, 45 miles 284° true, and 73 miles $278^{\circ} 30'$ true, from Nihoa Island.

FROST SHOAL

lies about 90 miles $296^{\circ} 30'$ true (WNW $\frac{5}{8}$ W mag.) of Nihoa, in latitude $23^{\circ} 45'$ N, longitude $163^{\circ} 25'$ W. This shoal is about 14 miles long in an easterly direction, with depths of 12 to 63 fathoms. It has not been surveyed and vessels are cautioned to give the locality a wide berth.

NECKER ISLAND

is a rocky island lying about 155 miles 281° true (W mag.) of Nihoa, in latitude $23^{\circ} 35' 30''$ N, longitude $164^{\circ} 39' 58''$ W. The island has four peaks, 235 to 300 feet high, one near each end and two between them, connected by a ridge. The sides of the island are precipitous, with 5 to 8 fathoms alongside. East Cove and West Cove are the only places where a landing can be made, and then it is only possible in fine weather. Detached rocks, about 10 feet high extend about 100 yards eastward from the easterly end of the island. Anchorage can be had anywhere under the lee of the island, in 8 to 15 fathoms, about $\frac{1}{2}$ mile offshore. Necker Island is near the north end of a bank reported to extend 50 miles to the south, with depths of 14 fathoms or greater reported. This bank also probably extends to the northeast 15 miles and to the northwest 7 miles.

TIDE.—The rise and fall of the tide is about 2 feet.

CURRENT.—A current sets westward on the north side of the island and circling around sets eastward on the south side.

WINDS.—September is said to be the calmest month in the year; strong north and northeast winds are said to be frequent during the other months.

FRENCH FRIGATE SHOAL,

lying 90 miles 278° true ($W \frac{1}{4} S$ mag.) of Necker Island, is a crescent-shaped atoll with a number of sand islets on it. A rocky islet about 180 feet long, 45 feet wide, and 120 feet high, lies about midway between the points of the crescent, in latitude $23^{\circ} 46' N$, longitude $166^{\circ} 18' W$. The islet is so steep and rugged that it is almost inaccessible. It is visible for about 8 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 ($SSE \frac{1}{4} E$ mag.) and 310° true (NW by $W \frac{3}{8} W$ mag.) from the rocky islet. Water, somewhat brackish, but not unwholesome, has been found by digging wells 8 to 10 feet deep on the sand islets, back from the beach.

ANCHORAGE can be had anywhere inside the reef in from 5 to 15 fathoms, mostly coral with some sandy bottom. There is an excellent anchorage about 1 mile northwestward of the rocky islet, in 13 to 14 fathoms, well protected. The rocky islet can be approached within 200 yards by vessels of any size with safety.

DIRECTIONS.—Entering from southward, head for the rocky islet on a 0° true (N by W mag.) course, passing between the southern horn and the breakers reported 3 miles westward of it. Entering from westward, head for the rocky islet on a 124° true (ESE mag.) course. Apparently there are no dangers outside the line of breakers; however, a sharp lookout is advisable.

CURRENT.—The current in this vicinity sets southwestward.

BROOKS SHOAL,

lying 30 miles 304° true (WNW mag.) of French Frigate Shoal, appears to be an oblong bank about 14 miles long in a west-north-westerly direction, on which a least depth of 14 fathoms has been found. The approximate geographic position of the shoal is latitude $24^{\circ} 10' N$, longitude $166^{\circ} 53' W$. Soundings taken over the shoal indicate that the bottom is very irregular, with deep holes in places. In 1910 soundings with a least depth of 18 fathoms were found northwestward of Brooks Shoal in latitude $24^{\circ} 29' N$, longitude $167^{\circ} 12' W$.

GARDNER ISLAND

is a rocky island lying 120 miles 309° true (NW by $W \frac{1}{2} W$ mag.) of the rocky islet at French Frigate Shoal, in latitude $25^{\circ} 01' N$, longitude $167^{\circ} 59' W$. It is an inaccessible rock 170 feet high and 200 yards in diameter, with a smaller rock close to its southwesterly extreme, from which a reef extends about $\frac{1}{2}$ mile. A bank, with 17 to 20 fathoms, surrounds the rock, extending about 5 miles northwestward, northeastward, and southeastward, and from 10 to 12 miles southwestward.

TWO BROTHERS REEF

(existence doubtful) is placed on the charts in latitude $24^{\circ} 14' N$, longitude $168^{\circ} 28' W$. It is reported as having been struck by a whaling ship in 1823. Several vessels have searched for the reef without finding it, and great depths were obtained at its reported position.

DOWSETT REEF,

lying 133 miles 278° true ($W \frac{1}{4} S$ mag.) of Gardner Island, is a rectangular coral reef, the center of which is in latitude $25^{\circ} 20' N$, longitude $170^{\circ} 30' W$. The reef is about 9 miles long in a westerly direction and about 5 miles wide. It is awash in places and is generally entirely covered by breakers. The bank surrounding the reef on which are 10 to 20 fathoms extends from 5 to 10 miles off. A depth of 16 fathoms is reported to lie 60 miles $72^{\circ} 30'$ true from Dowsett Reef.

MARO REEF,

lying about 10 miles northwestward of Dowsett Reef, is also rectangular, its center being in latitude $25^{\circ} 29' N$, longitude $170^{\circ} 35' W$. The reef is about 9 miles long in a westerly direction and about 5 miles wide. It is generally covered with breakers, the heaviest being near the northwesterly end. The reef is nearly surrounded by a bank on which are soundings of from 10 to 30 fathoms, extending from 2 to 7 miles off, and deepening gradually from the reef. Both Dowsett and Maro Reefs should be approached with caution, the breakers at times being very light and scarcely distinguishable from whitecaps.

LAYSAN ISLAND

is a small, low island lying about 65 miles 280° true ($W \frac{1}{8} S$, mag.) of Maro Reef, in latitude $25^{\circ} 42' 14'' N$, longitude $171^{\circ} 44' 06'' W$. The island is about $1\frac{3}{4}$ miles long, 1 mile wide, 55 feet high, and covered with scrub. Near the center of the island there is a salt-water lagoon about 1 mile long. Water of tolerable quality may be obtained from shallow wells, and sea fowl, eggs, and fish are abundant. The island is surrounded by a fringing reef from 100 to 500 yards in extent, outside of which is a bank about 6 miles wide, with from 14 to 60 fathoms, beyond which the water deepens rapidly. No dangers exist beyond the line of breakers. Inside the fringing reef there is a narrow boat passage nearly around the island, with an opening on the west side large enough to admit the passage of lighters to the landing. Vessels can only visit this island with safety between the months of April and September, when the northeast trades prevail.

ANCHORAGE may be found anywhere on the westerly side of the island, about $\frac{1}{2}$ mile offshore, in 8 to 12 fathoms, rocky bottom. The holding ground is poor.

CURRENT.—The current appears to set northward and westward. Close to the island the current is affected by tidal action. The wind has a strong effect on the current, and with a sudden change the current may shift almost as quickly.

LISIANSKY ISLAND

is a small, low coral island lying about 117 miles 279° true ($W \frac{1}{8} S$ mag.) of Laysan Island, in latitude $26^{\circ} 00' N$, longitude $173^{\circ} 50' W$. The island is about 1 mile long, $\frac{1}{2}$ mile wide, 44 feet high, and overgrown with bushes. Brackish water, barely drinkable, may be obtained by digging a few feet, and birds, fish, and turtle are abundant. The island is encircled by a reef, which, on the westerly side, forms

a lagoon $2\frac{1}{2}$ miles wide in which there is good anchorage in from 3 to 6 fathoms. The island should be visited only between the months of April and September, inclusive. The principal entrance to the lagoon is marked by two heavy breakers bearing north and south from each other, $\frac{3}{4}$ mile apart, and about 2 miles westward of the island. Between these two breakers are several small rocks awash, which may be avoided by conning from aloft. Inside the lagoon are a number of scattered rocks, but as the water is smooth they are easily avoided. The best anchorage for vessels drawing 13 feet or less is $\frac{1}{4}$ mile offshore, in 3 fathoms, sandy bottom. The approach should be made from northward. When about 5 miles distant from the island, depths of 18 to 20 fathoms will be found, with large coral bowlders on the bottom distinctly visible. Steer westward skirting the edge of the reef, which at this point is a fairly continuous coral ledge, until the south end of the island bears 96° true (E $\frac{1}{2}$ N mag.), when the entrance, heretofore described as being marked by two heavy breakers, having a depth of 4 fathoms, will be plainly visible.

Neva Shoal is a dangerous reef lying $1\frac{1}{2}$ miles east-southeastward of the southeasterly end of the island. A submerged rock, marked by breakers, is reported to lie $2\frac{1}{2}$ miles 244° true (SW $\frac{3}{4}$ W mag.) of the southwesterly end of the island. Lisiansky Island is surrounded by the usual bank, with no outlying dangers, to a distance of 5 or 6 miles, except southward and eastward, in which direction a dangerous bank, covered with sand and coral reefs, extends about 30 miles. In 1900 a vessel struck at a point 12 miles southeastward of the island and remained entangled 14 days by the reefs and shoals. Vessels should give the island a wide berth when passing southward of it.

TIDES.—The rise and fall of the tide is about 1.5 feet, much influenced by the winds.

CURRENT.—During the winter months strong northwesterly currents prevail.

PEARL AND HERMES REEF,

lying about 155 miles 315° true (NW by W mag.) of Lisiansky 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 $27^\circ 48' N$, longitude $175^\circ 51' W$. There is an entrance to the lagoon on the northwesterly side, through which there is 1 to 6 feet with numerous coral heads. Inside the lagoon there is an anchorage in 3 to 15 fathoms, but the islands can not be approached within 2 miles. The largest island bears 119° true (ESE $\frac{3}{8}$ 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, or on the easterly side of the reef. There is shoal water $\frac{1}{2}$ mile from the head of the bight on the easterly side, 9 fathoms being the depth reported. On the westerly side the bottom slopes off gradually to 35 fathoms 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 Lisiansky Island and Pearl and Hermes Reef.

GAMBIA BANK,

lying about 35 miles 293° true ($WNW \frac{7}{8} W$ mag.) of Pearl and Hermes Reef, in latitude $28^{\circ} 07' N$, longitude $176^{\circ} 38' W$, has 14 fathoms over it and the bottom can be plainly seen.

MIDWAY ISLANDS

is a circular atoll about 6 miles in diameter, inclosing two islands. The narrow encircling reef is about 5 feet 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 $1\frac{1}{4}$ miles long, 6 to 12 feet 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 about $\frac{1}{4}$ mile from the east shore of the island is quite prominent.

Sand Island, on the southerly side of the reef, is $1\frac{3}{4}$ miles long and composed of white coral sand. It has a greatest elevation of 43 feet 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 $28^{\circ} 13' 15'' N$, longitude $177^{\circ} 21' 30'' W$.

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, which is dangerous in westerly and southwesterly weather. The deepest draft entering the harbor is about 17 feet, but a pilot is needed when vessels draw over 15 feet. 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; $\frac{1}{2}$ mile northward of it is **Middle Ground**, on which the sea generally breaks. The entrance is $\frac{1}{2}$ 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 ($SE \frac{1}{4} E$ 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 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 $\frac{3}{8}$ mile inside the bar, course $115^{\circ} 30'$ true ($ESE \frac{3}{4} E$ mag.). A spot with 15 feet over it lies in Seward Roads on the range line, with the right tangent of the outer

reef on the south side of the entrance bearing about 200° true (S $\frac{7}{8}$ W mag.), and there are numerous shoal spots and foul ground southward of the range to the reef. The front beacon is a 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.

CABLE.—The cable between San Francisco, Honolulu, Guam, and Manila touches at Midway Islands. To avoid following the cables in Seward Roads, vessels should anchor northward and not within 200 yards of the Welles Harbor range line.

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 $\frac{1}{2}$ mile westward from the northwest end of Sand Island, in $4\frac{3}{4}$ fathoms. 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 $4\frac{1}{2}$ to 5 fathoms, picking out a sandy spot to drop the anchor. Outside of North Breakers anchorage can be selected in 6 to 12 fathoms, choosing any one of the numerous sandy spots, the bottom anywhere about the island being visible up to 10 fathoms. To avoid the cables, keep the south end of North Breakers bearing eastward and southward of 90° true (E $\frac{7}{8}$ N mag.). A good anchorage is on the entrance range, in 9 or 10 fathoms, 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, through the reef westward of Eastern Island, and a depth of 5 to 10 feet, thence to the northeast end of Sand Island.

SUPPLIES.—Water can be had on Sand Island.

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.

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 spot on 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, as the channel is less than 200 feet wide between spots with 12 and 16 feet over them. Continue on the range, course $115^{\circ} 30'$ true (ESE $\frac{3}{4}$ E mag.), and when about $\frac{1}{4}$ mile inside the bar pass between two coral heads with 12 and 14 feet and a channel 200 feet wide between them. After passing these heads and up with the black and white perpendicularly striped can buoy, stand northeastward to the anchorage. Or, when nearly up with the can buoy, turn southward and pass between the Hook (a large coral patch, from which a shoal extends about 200 feet) and the crescent-shaped shoal, which generally shows up as a good mark. Then haul eastward and steer for the rear beacon of the Welles Harbor range, course 109° true (E $\frac{3}{4}$ S mag.). Pass northward of several small coral heads (least depth 11 feet), and anchor near the last range, near the middle of the basin, in $4\frac{3}{4}$ fathoms, sandy bottom.

Bank near Midway Islands.—In 1899 a bank with 82 fathoms over it was discovered 35 miles southwestward of Midway Islands, in latitude $27^{\circ} 58' N.$, longitude $177^{\circ} 55' W.$

OCEAN (CURE) ISLAND,

lying about 56 miles 280° true (W mag.) of Midway Islands, in latitude $28^{\circ} 25' N.$, longitude $178^{\circ} 25' W.$, 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 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 high. A bank with 20 to 30 fathoms 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, 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 $30^{\circ} 55' N.$, longitude $177^{\circ} 30' E.$ The chart gives a depth of 42 fathoms. In 1901 and 1902 this position was sounded over, and no bottom was found at 100 fathoms.

CURRENTS.—A set to the southward has been observed between Ocean 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 $\frac{1}{2}$ mile long in an east-northeasterly direction; its easterly end is in latitude $16^{\circ} 45'$ N., longitude $169^{\circ} 32'$ 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 $1\frac{1}{2}$ 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, 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 $\frac{7}{8}$ N mag.) course. On this course the edge of the reef will be found in 7 fathoms about 5 miles from the island, with irregular depths of $5\frac{1}{2}$ to 12 fathoms, until within 1 mile of the island, when an anchorage can then be had. On this course shoal spots, with apparently as little as 4 fathoms 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.

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 $16^{\circ} 08'$ N., longitude $178^{\circ} 58'$ W. The reef appeared to be about $1\frac{1}{2}$ miles long in a northerly direction and about $\frac{1}{2}$ 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 $22^{\circ} 15'$ N., and longitude $175^{\circ} 37'$ W. Capt. R. Suffern, of the bark *Craigierne*, 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 $21^{\circ} 55'$ N., and longitude $176^{\circ} 05'$ W., or about 35 miles southwestward of the charted position of Krusenstern Rock.

Palmyra Island (latitude $5^{\circ} 52'$ N., longitude $162^{\circ} 06'$ 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.

NAVIGATIONAL AIDS AND THE USE OF CHARTS.

The 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 Notice 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 late 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 issue, 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 can not be clearly charted. The charts are various in character, according to the objects which they are designed to subselve. The most important distinctions are the following:

1. Sailing charts, mostly on a scale of approximately 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 1:100,000 and 1:200,000, intended especially for coastwise navigation.

3. Coast charts, on a scale of 1:50,000, 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 1:200,000, 1:100,000, and 1:50,000; coast charts are on scales 1:200,000 and 1:100,000.

COAST PILOTS, relating to surveyed waters of the United States, Porto Rico, Alaska, Hawaiian Islands, and the Philippine Islands, contain full nautical descriptions of the coast, harbors, dangers, and directions for coasting and entering harbors. From time to time, as the material accumulates, 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., provided the volume itself has not been 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 time and height of the tides 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 more than 3,000 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.

CURRENT TABLES, which have heretofore been issued as a part of the Tide Tables, are now published separately as Current Tables, Atlantic Coast of the United States, and Current Tables, Pacific Coast of the United States.

AGENCIES for the sale of the Charts, Coast Pilots, Tide Tables, and Current Tables of the Coast and Geodetic Survey are established in many ports 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. If ordered by mail, prepayment is obligatory. Remittances should be made by postal money order or express order, payable to the "Coast and Geodetic Survey." Postage stamps, checks, and drafts 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 Office, Washington, D. C.

OTHER PUBLICATIONS.—Lists of Lights, Buoys, and other Daymarks 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. These publications can be obtained free of charge on application to the Division of Publications, Department of Commerce, Washington, D. C.

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 and the Philippine Islands. The early Russian and Spanish 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 on the chart by two broken lines to represent the side limits of the improvement. Before completion of the project the depth given is that shown by the latest survey received from the engineer in charge. After completion the depth given is the one proposed to be maintained by dredging when necessary. The actual depth of a completed channel may be greater than the charted depth shortly after dredging and less when shoaling occurs as a result of storms or other causes. These changes are of too frequent occurrence and uncertain duration to chart. Therefore, when a vessel's draft approximates the charted depth of a dredged channel, the latest information should be obtained before entering.

DANGER CURVES.—The curves of depth 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 shallower 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 can not 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 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.—The paper on which charts are printed has to be dampened. On drying distortion takes place from the inequalities in the paper, which varies with the paper and the amount of the original dampening; but it is not sufficient to affect ordinary navigation. It must not, however, be expected that accurate series of angles taken to different points will always exactly agree when carefully plotted upon the chart, especially if the lines to objects be long. The longer the chart the greater the amount of this distortion.

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.

GAS 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 distances given in the light lists and on the charts for the visibility of lights are computed for a height of 15 feet 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.

When looking for a light, the fact may be forgotten that from aloft the range of vision is increased. By noting a star immediately over the light a bearing may be afterwards obtained from the standard compass. 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 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.

SUBMARINE BELLS have an effective range of audibility greater than signals sounded in air, and a vessel equipped with receiving apparatus can determine the approximate bearing of the signal. These signals can be heard also on vessels not equipped with receiving apparatus by observers below the water line, but a bearing of the signal can not then be readily determined.

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 flood or ebb tide. In some localities the rise or fall may be at a 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 Porto Rico the plane of reference for soundings is the mean of all low waters; for the Pacific coast of the United States and Alaska, with the two exceptions noted below, and for the Hawaiian and Philippine Islands, it is the mean of the lower low waters. For Puget Sound, Wash., the plane of reference is 2 feet below mean lower low water and for Wrangell Strait, Alaska, it is 3 feet below mean lower low water. 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. 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 times 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, though 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.

Where there is a large tidal basin with a narrow entrance, the strength of the current in the entrance may occur near the time of high and low water, and slack water at about half tide, outside. 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 straights, 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 their 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 barring of the propeller and rudder.

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 of 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, also, 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 obtained 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 bearings or angles for 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 displacing 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 three-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 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 before the position is obtained. By taking the bearings 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 cases 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 is 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 and Spanish 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.

SUMNER'S METHOD.—Among astronomical methods of fixing a ship's position the great utility of Sumner's method 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 Sumner 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.

RADIO COMPASS positions are especially valuable at night during fog or thick weather when other observations are not obtainable. For practical navigating purposes radio vibrations 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 (see p. 4, Radio Service); secondly, where the bearings of two or more known shore radio stations are determined on the vessel itself and plotted 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 station are a long distance apart. The bearings may be corrected for this distortion, or still greater accuracy may be obtained by plotting the observed bearings on a special chart on the gnomonic projection.

Radio bearings may be combined with position lines obtained from astronomical observations and used in ways very similar to the well-known Sumner line when avoiding dangerous shoals or when making the coast.

For plotting radio compass bearings the U. S. Coast and Geodetic Survey publishes three plotting charts, which may be obtained by application to the Director, Coast and Geodetic Survey, Washington, D. C., or the sales agents, price 20 cents each. Full directions for using them are printed on the reverse side of each chart.

CHANGE OF VARIATION OF THE COMPASS.—The gradual change in the variation must not be forgotten in laying down positions by bearings 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 reengraved for every 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 deflections 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 temporarily 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 disturbances 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 the 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—i. e., 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, such as 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; e. g., 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 seem 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 circumstances the effect can not 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 case 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.

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 vessels, whose safety is entirely dependent upon an accurate knowledge of the depths. Efforts have been made from time to time by the Coast and Geodetic Survey to utilize tubes for surveying operations.

In practical tests, carefully made by surveying parties, where up-and-down casts of the lead were taken with tubes attached to the lead, errors in the tube amounting at times to as much as 25 per cent of the actual depths have been noted. Errors of 10 to 12 per cent of the actual depth were quite common. It is also worthy of note that in the great majority of cases the tubes gave depths greater than the true depths, which, in actual use in coastwise navigation, would usually have resulted in the conclusion that the ship was farther offshore than was really the case.

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 general principle that air is

elastic and can be compressed, and that if a column of air in a tube be lowered into the water in such a way that the air can not escape, yet at the same time, the pressure of the water can be transmitted to it, the amount by which the air is compressed furnished a measure of the depth to which it was lowered. Theoretically this principle is sound, but when we come to apply the theory to actual practice certain elements enter which result in errors in the depth determination. It is important to note that the amount of these errors depends on the depth; the greater the depth the greater the numerical value of the error. The causes which produce these errors are as follows:

1. In order to give correct results, the bore of the tube must be exactly cylindrical. In other words, the volume of air in any 1 inch of length of the tube must be exactly the same as in an inch in any other part. But because of the way in which glass tubes are made it is very difficult to accomplish this. The bore may taper slightly or vary in other ways from a true cylinder. If tapering, the minimum diameter of bore may be at the top, middle, or bottom of the tube as submerged. If the minimum diameter be at the top, the tube will register depths less than the actual depths of water, and if at the bottom the registered depth will be greater than the true depth. This defect may be detected in a suspected tube by introducing a small quantity of mercury into the tube and comparing its length at different points along the bore. For satisfactory results the length of this column should not vary more than 5 per cent.

2. In order that even a perfect tube should give accurate results, the conditions of barometric pressure and air and water temperatures under which the sounding is being taken must be the same as those under which the scale for reading the depths was made. In making the scale a barometric pressure of 29 inches is usually assumed as normal. Then, if in actual use, the barometer registers above normal, the air in the tube is already partly compressed, and when lowered to any given depth the amount of compression due to water pressure is correspondingly diminished. With a barometer below normal the reverse is true, and it therefore follows that when the barometer reads above normal the tubes will register less than the true depths, whereas if the barometer reads below normal the registered depths will be greater than the true. The amount of error introduced from this cause is about 3 per cent of the depth for each inch of barometric pressure above or below normal.

The density of the air in the tube also depends directly upon its temperature. Therefore, the difference between the temperature of the air in the tube before and after submergence will affect the accuracy of the sounding. Where the temperature of the tube in the air is greater than that of the tube in the water, the depth recorded will be greater than the actual depth, and, conversely, when the temperature of the air is lower than that of the water the depth recorded will be less than the true depth. Also, the temperature of the water may vary at different depths, so that the actual amount of this error depends on the difference between the temperatures of the tube in the air and at the bottom. The amount of error introduced from this cause is about 1 per cent of the depth for each 3° F. difference in temperature.

3. While the tubes are usually 24 inches long and the scales are designed for that length of tube, the manner of closing the upper end of the tube may introduce an error. The thickness of the caps used for this purpose varies considerably in different makes of tubes, even when such caps are made of the same material. This variation in thickness results in moving the tube slightly up or down in the scale. Thus, with a thin cap the sounding read from the scale will be too deep; with a thick cap, the sounding read will be less than the true depth.

Copper caps put on with sealing wax have been found to vary sufficiently to produce errors of about 5 per cent of the depth in depths of 50 to 70 fathoms. Rubber caps seem to be more nearly uniform and to give better results when new. Rubber, however, deteriorates, and when used too long there is apt to be leakage of air. When removable caps are used, care should be taken to see that they are pushed home thoroughly before sounding.

4. The integrity of the air in the tube should be carefully preserved. Even a slight leakage of air will result in showing a sounding considerably in excess of the true depth. Vessels sometimes approach dangers coming from depths of over 100 fathoms. As they approach they begin feeling for the bottom, sounding at infrequent intervals to pick up depths of 75 to 100 fathoms. So long as they get no bottom in such depths navigators feel secure. But a leaky tube may show no bottom at 100 fathoms when the ship is actually in much less depths, possibly resulting in disaster before the error is discovered. Special precautions should, therefore, be taken on this point. Copper caps should be sealed in place with sealing wax, and rubber caps should be supplied with wire clamps, giving a tight fit.

5. Accumulated salt on the inner surface of the tube will cause the watermark to creep up and register greater than true depths. The type of tube exemplified by the well-known Bassnett sounder is based on the same principle as the ordinary glass tube.

but is more complicated in design. It consists, essentially, of a metal case containing a glass tube closed at the upper end. Inside the glass tube is a metal tube, through which the water enters and is trapped by a valve at the top of the metal tube. In this device the scale is graduated directly on the glass tube, thus eliminating those errors due to thickness of cap; but, on the other hand, the possibility of errors increases directly with the number of working parts of which the sounder is made. In using sounders of this type care should be exercised to preserve perfectly gasketed joints between the bottom of the glass tube and the metal case and to keep the outlet valve well oiled and water-tight.

Leaking valves and water remaining in the tube before a sounding is taken will give increased depths, while deficient depths may be recorded as a result of loss of water through suction at the inlet as the tube is being reeled in. The Bassnett type, in common with all other forms of pressure tube, is subject to the above-described errors due to variations in temperature and barometric pressure.

It will be noted that wherever the amount of the various errors can be stated they are all small. Their importance lies in the fact that two or more of them acting together, may result in considerable errors. As already stated, actual experiments show that errors of 10 to 12 per cent are not uncommon and that considerably greater errors may occur. There are certain precautions which can be taken to eliminate or reduce these errors:

1. In purchasing tubes a type should be selected which can be used until broken or lost. The navigator can then make a study of the results obtained from each individual tube and thus gain a fair idea of its accuracy under known conditions. This necessitates some permanent means of identifying the various tubes used, which may readily be accomplished in the case of the glass tubes by means of various colored paints or threads.

2. 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. It is well to keep a permanent record of the results of each tube tested. By so doing the navigator will soon obtain valuable information as to the performance of the various tubes and the degree to which they may be trusted. Such a record should, of course, take into account the various conditions affecting the result. It will be noted that the factors which produce errors may be divided roughly into three groups:

- (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 valves, errors due to the presence of salt in the tube, etc.

These 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. But, on the other hand, they occur only as a result of a few known causes, already enumerated, and therefore by the exercise of proper caution in the use of the tubes they may be to a large extent eliminated. If the ordinary glass tube is used, see that the bore is thoroughly dry and free from salt and that the cap makes a tight fit. If using a sounder, see that the tube is free from water and that the valves are tight and well oiled. And, above all, during the course of the sounding take an occasional up-and-down cast as a check, for by that means alone can one be sure that the proper results are being obtained.

The smallest possible number of tubes should be used. It is obviously much better to use over and over again one tube which is giving good results than to use a number whose errors are uncertain. This is particularly desirable where sounders involving valves are used. If a tube shows no bottom at 100 fathoms, examine the arming to make sure that the lead actually failed to find bottom.

Finally, beware of overconfidence. Tubes which have been working properly for a number of soundings suddenly develop errors. It is chiefly for this reason that they have been discarded for surveying operations. Assuming that the accidental errors can be reasonably controlled, the inherent and external errors present no serious difficulty.

As already indicated, the bore of a tube (or at least of any tube which is capable of constant use) can be tested with mercury, and those tubes rejected which show variations in bore greater than about 5 per cent. Errors due to variations in the thickness of caps can be eliminated by using a scale graduated for a true length of 24 inches (the length of the glass tube) and removing the cap before the sounding is read. Errors due to differences between air and water temperatures can be reduced to a minimum which can usually be neglected by immersing the tube before using in a bucket of sea water newly drawn, so that its temperature has not had time to change. Care should, of course, be taken to see that no water enters the tube. When this is done, there may still remain an error due to the difference in temperature of the water at the surface and at the bottom. This may, if desired, be corrected by sending down a self-registering thermometer with the lead, but for the ordinary purposes of navigation this is a refinement which may be ignored. There is no ready method available for correcting the error due to variations in the barometric pressure. The correction should be applied to the sounding recorded.

It is interesting to note that sounding tubes which give good results can readily be made from plain glass or metal tubes aboard ship—gauge glasses, for instance. One end of the tube is closed with a cork and sealing wax. A narrow strip of chart paper of uniform width, on which a line has been ruled with an indelible pencil, is inserted the entire length of the tube. The paper is held in place by bending the projecting lower end upward along the outside of the tube and securing it with a rubber band. The height in which the water rises in the tube will be indicated by the blurring of the pencil line.

If the air column in the tube is 24 inches long, the sounding may be read from any scale graduated for tubes of that length. If of a different length, a special scale must be prepared; its graduations, compared to those of the 24-inch scale, will be proportional to the comparative lengths of the two tubes. If certain precautions are taken, these tubes will give results which compare favorably with commercial tubes. The paper should be inserted uniformly in the tube, and its upper end, or a mark from which the measurement is taken, should coincide with the top of the air column. Metal tubes have the advantage of uniform bore, but if metal tubes are used the paper, in order to insure uniformity, should be fastened at the upper end when that end is being sealed and then stretched lightly at the bottom. The depth should always be read from the dry portion of the paper, as the wet portion is subject to considerable change in length.

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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.

(h) The master of any vessel requiring a pilot to conduct his vessel to sea must make application to the harbor master.

(i) 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.

(k) 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.

(o) 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.

(p) 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 per cent 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 per cent 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 sailing 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 35. (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 watercraft 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 2 cents per ton per diem on the net registered tonnage of the vessel, except as otherwise provided in Rule X, b.

(b) All watercraft 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 2 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 1 cent per diem per ton on the net registered tonnage: *Provided further*, That all watercraft lying idle, outside of other watercraft lying at a wharf, and all watercraft undergoing repairs, shall pay the sum of 1 cent 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 watercraft 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 watercraft 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 watercraft 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 watercraft, and as a part of the trip of such watercraft, 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 1 cent per ton per diem on the net registered tonnage of the vessel, except as otherwise provided for in d of Rule X.

(d) Any watercraft 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:

8 hours or less.....	\$0.0025
Over 6 hours and less than 12 hours.....	.005
12 hours or more and less than 18 hours.....	.0075
18 hours or more and less than 24 hours.....	.01

Provided, however, That if any such watercraft, during a trip, shall so use only one wharf, pier, quay, bulkhead, or landing during a day of 24 hours, and for a less period than 12 hours the charge therefor shall be \$0.005 per ton: *Provided further,* That if any such watercraft, during a trip, shall so use only one wharf, pier, quay, bulkhead, or landing during a day of 24 hours, and for a period of 12 hours or more, the charge therefor shall be \$0.01 per ton.

(e) Any wharf, pier, bulkhead, 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: *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.

RULE XI.—DEMURRAGE.

(a) On 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 charge 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. 10 channel buoy, 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. 10 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.

(g) *Sailing vessels.*—1. All sailing vessels, upon entering the port of Honolulu, will be required, when directed by the harbor master or his assistant, to make a tugboat fast alongside when abreast of the Honolulu Harbor Lighthouse, and to keep the tug alongside until the vessel is in her berth, so that the vessel will, at all times, be under control.

2. All sailing vessels when entering Honolulu Harbor in tow of a tugboat which is not powerful enough to tow alongside will be required, when directed by the harbor master or his assistant, to have a tugboat astern in addition to the tugboat ahead, when abreast of the Honolulu Harbor Lighthouse, so that the way of the vessel may be regulated at any time until the vessel is in her berth.

(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 loosing, of any warp or rope, or unshackling or loosing 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.

(m) Vessels, when being moved into a slip or alongside, must approach "head on," and when at the pier must lie head toward the shore; the studding-sail, booms and sprit-sail yards must be rigged in; their offshore anchors suspended, ready for dropping; their lower and topsail yards braced "sharp up" on their offshore braces, except when in actual use in discharging or unloading cargoes; and their jib booms and martingales must be rigged in. Any of the above requirements may be dispensed with on receiving permission, in writing, from the harbor master.

(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.

(v) No vessel or craft of any description shall enter or depart from Honolulu Harbor from one-half hour after sunset until sunrise. Vessels of over 15 tons (registered classes) may move from pier to pier within Honolulu Harbor during day or night.

Vessels under 15 tons are prohibited from any movement whatsoever in Honolulu Harbor from one-half hour after sunset until sunrise, except ships' row boats, where said ships are anchored in the stream.

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) Masters, 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 un-

loading 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 the 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 of any of the following ports: Honolulu, Hilo, Lahaina, Kihei, Honuapo, Kailua, Nawiliwili, Napoopoo, or such other ports as may be designated from time to time by 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 or under control of the board, is strictly prohibited.

RULE XV.—CONCERNING CARE OF WHARVES, HARBORS, AND STREAMS.

(a) No person shall hold an auction sale, sell, or expose for sale any goods on any wharf or landing place, nor carry on any trade thereon without having obtained written permission from the board.

(b) No person shall clamber on or about the structure of any wharf below the deck level. No boat or raft shall be allowed under any wharf structure.

(c) No person shall exhibit, or place any placard, notice, or advertisement on any portion of the wharves, sheds, waiting rooms, or offices without the written permission of the board.

(f) Any vessel, or any person causing any damage to any wharf, shed, or other structure, or any property of the Territory under the jurisdiction of the board, shall be liable for such damage.

(g) The board shall not be liable for damage to, or loss of, any merchandise or other property in any storehouse or on any wharf, pier, bulkhead, quay, or landing.

(h) The harbor master or wharfinger shall have the power to close the wharves or any portion thereof and to regulate and control the use thereof by the public whenever it is advisable to do so for the safety and preservation of persons or property or the maintenance of order, and no person shall enter upon any wharf so closed without the consent of the harbor master or wharfinger.

(i) Any person landing goods on any wharf, or bringing goods thereon for shipment, shall place, store, and stack such goods in such manner as the harbor master or wharfinger may direct; and no goods or other articles shall be placed in any shed or on any wharf so as to be an impediment to the approaches of, or an obstacle to the removal of, other goods from such shed or wharf, or so as to encumber mooring bits or

mooring rings, or any other devices used for mooring purposes; and every person landing or bringing such goods on any wharf shall keep all tracks, water taps, gutters, drains, and hydrants clear; and no goods for export shall be placed on any wharf or in any shed, without the permission of the harbor master or wharfinger.

(j) No goods or articles of any description which, in the opinion of the harbor master or wharfinger, are likely to occasion any damage to any wharf or shed, or any merchandise stored thereon or therein, shall be discharged or landed on any such wharf, or placed in any such shed.

(k) No animal shall be allowed to remain upon any wharf for a period longer than 24 hours without written permission of the harbor master or wharfinger, and any animal remaining for a longer period without such permission may be removed by the harbor master or wharfinger at the expense of the consignee.

(l) No person shall land any rubbish, ashes, or refuse on any wharf or landing place without the permission of the wharfinger or harbor master.

(m) No person shall place or leave upon any wharf, or in any shed, any vegetable or animal matter, or goods which are in a state of decay or putrefaction; and any goods which, in the opinion of the harbor master or wharfinger, are unfit to remain on any wharf under the jurisdiction of the board, or harmful to other goods stored on the wharf or in any shed, shall be removed from such wharf or shed by the wharfinger or harbor master, and the consignee or owner of such goods shall, upon demand, repay to the board the cost of such removal.

(n) All persons are prohibited from placing, or causing to be placed, any dead animal on any wharf or landing, or in the waters, or on the shores of any harbor under the control of the board, or upon any reef adjacent to any such harbor; and no person shall move, or cause to be moved, any dead animal through the waters of any such harbor without the written consent of the harbor master.

(o) No substance that will sink, or rubbish, garbage or refuse shall be thrown into any stream, or into any harbor, or upon any wharf in the Territory of Hawaii and under the control of the board.

(p) No person shall deposit ballast, rock, stone, slate, slag, gravel, sand, earth, cinders, rubbish, filth, or any other substance, on any of the shores, lands, or other property under the control of the board without the written permission of the board.

(q) When any ballast, stone, coal, bricks, ashes, cinders, dust, rubbish, or other loose matter or material that will sink, is being landed from any vessel upon a wharf, or being transferred from one vessel to another within any harbor or stream under the control of the board, a canvas chute, or some other contrivance satisfactory to the harbor master or wharfinger, shall be used to prevent any part of the substance that is being handled from falling into the waters of the harbor or stream.

RULE XV-A.—CONCERNING CARE OF ANIMALS ON WHARVES.

No fowl, animal, or live stock of any kind shall be allowed to remain on any wharf for a period longer than six hours without being properly fed and watered. If any such live stock shall be allowed to remain upon any wharf for a longer period than six hours without being so properly fed and watered, the harbor master or wharfinger may provide such livestock with proper feed and water or may remove the same to the nearest Territorial quarantine station for such care and treatment. All expenses incurred in the care and maintenance of such live stock pursuant to this rule shall be paid for by the consignee thereof and shall constitute a lien upon such live stock until the same are paid.

RULE XVI.—LOADING FOR WHARVES.

(a) Wharves may be loaded up to the limits as stated in these regulations, but in no case will loads in excess of these be allowed, except as herein provided. Wherever loads in excess of these specified are contemplated, permission must be obtained from the board in writing and proper shoring and skids provided. This work must be done under the supervision of, and as directed by, a representative of the said board. The following are the maximum allowable loads: Piers Nos. 8, 9, and 10, in the port of Honolulu, 500 pounds per square foot over the area supported by piles, cylinders, or sea wall; 1,000 pounds per square foot over the balance of the area on solid fill; Kuhio wharf, in port of Hilo, 500 pounds per square foot over the area supported by piles and 1,000 pounds per square foot over area on solid fill; all other wharves, 250 pounds per square foot over the piles and wooden structure and 1,000 pounds per square foot over the area on solid fill.

(b) Concentrated loads shall be distributed by planks, skids, or shoring, so as to give a distributed loading which will not exceed 30 per cent of the maximum loads allowed for that particular wharf. The method used for distributing such concentrated loads shall be subject to the direction of a representative of the board.

(c) No overload will be allowed to remain on the piled area, but must be removed to the solid fill waiting transportation. Impact loads caused by self-dumping wagons, or by violent discharge of loads from wagons, or from slings will not be allowed.

(d) Coal shall be placed on one-fourth inch steel plates, at least 8 by 16 feet in size, such plate to be furnished by the consignor or the consignee.

(e) No single piece of merchandise weighing over 7½ tons will be permitted on any wharf without written permission from the harbor master.

(f) When vessels are discharged by means of a chute, a one-fourth inch 8 by 8 feet steel plate must be provided at the foot of the chute to receive the impact of cargo so landed.

RULE XVII.—STORAGE ON WHARVES.

(a) Applications 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) The rental charge for storage space shall be 2 cents per square foot per month: *Provided*, That storage charges for sugar shall be 6 cents per ton.

(c) When monthly rates are charged, fractional parts of months shall be regarded as full months, and the full rate per month will be charged.

RULE XIX.—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 for 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 XX.—CHARGES FOR MOLASSES PIPE LINES.

(a) The charge for the use of the molasses pipe-line shall be 2 cents per barrel of 42 gallons pumped through the line, whether from ships to tanks or from tanks to ships, or to other users of molasses.

(b) Firms, corporations, or individuals using the line must provide the necessary hose for connection with the receiving or discharging watercraft.

(c) Permits to use the line will be granted only to those applicants who are in position to deliver molasses to or from vessels berthed at Government wharves at a minimum volume of the normal capacity of the line per hour.

(d) Damage of any nature to wharf or to merchandise stored thereon caused by leaks from hose, or from carelessness in handling molasses hose, will be chargeable to the firm, corporation, or individual using the molasses pipe-line at the time the damage was done.

RULE XXI.—POWER, SAIL, AND ROWBOATS.

(a) All sampans and fishing boats, or any small watercraft using the waters of the harbors of Honolulu, Hilo, Port Allen, and Kahului, must moor in the berths allotted to them from time to time by the harbor masters at the said ports.

(b) The mooring charges for all such small watercraft will be as follows: *Provided, however*, That no mooring charges shall be made for craft used wholly for pleasure:

	Per month.
1. Sailboats.....	\$2
2. Power boats, 20 feet long and less than 40 feet.....	3
3. Power boats, 40 feet long and less than 60 feet.....	4
4. Power boats, 60 feet long and less than 80 feet.....	5
5. Power boats, 80 feet long and over.....	10

(c) All charges for said craft shall be paid at the office of the harbor master at Honolulu, Hilo, Port Allen, or Kahului on or before the 15th day of each month, between the hours of 7 and 10 a. m., and all charges not paid by such specified time of each month will be subject to a 25 per cent penalty: *Provided*, That the craft in question has been in port during the time mentioned; and all such craft which have not entered port between the 1st and 15th of the month must pay their charges as soon as they enter port after the said date.

(d) Any such watercraft which have not paid the charges due from them by the close of the month in which such charges fall due shall be deprived of all rights and privileges enjoyed by said craft under the jurisdiction of the board until all dues and penalties are paid.

(e) All watercraft using or taking gasoline or distillate as motor power in the harbors of Honolulu, Hilo, and Kahului will be required to take same from a tank wagon or tank station, through a hose, the lower connection of said hose to fit as tight as possible on the intake of the boat's tank, and any of the above-named craft taking her gasoline or distillate in drums must not transfer the same to her tanks while such craft is inside the waters of Honolulu, Hilo, and Kahului harbors.

RULE XXII.—DONKEY ENGINES AND DERRICKS ON WHARVES.

(a) Transportation companies, corporations, or individuals using donkey engines on wharves, said donkey engines being the property of the Territory of Hawaii, shall pay for the use of same the sum of \$2 per day, or part thereof, fuel and lubricating oil to be provided by the user of said donkey engines.

(b) Transportation companies, corporations, or individuals using derricks on wharves, said derricks being the property of the Territory of Hawaii, shall pay for their use \$1 per day, or part thereof.

SCHEDULE OF TOLLS COLLECTED ON FREIGHT PASSING OVER TERRITORIAL GOVERNMENT WHARVES.

DEFINITIONS—TOLLS.—The charge for cargo conveyed on, over, or through any territorial wharf, both inward and outward, or loaded or discharged while ship is moored in any slip, basin, or channel.

Foreign freight.—Incoming foreign freight to include all freight shipped to an island port from any port outside of the Hawaiian Islands. Outgoing foreign freight to include all freight shipped from an island port to any port outside of the Hawaiian Islands. Inter or intransit freight to include all freight shipped from one island port to any other Island port.

Incoming freight (foreign).¹

Rates of toll:	Rate.	Live stock:	Rate
General merchandise, per ton.....	\$0.15	Cattle, horses, and mules, per head....	\$0.50
Fertilizer, per ton.....	.05	Colts and calves (under a year old) per head.....	.25
Coal, per ton.....	.10	Hogs, per head.....	.10
Coke, per ton.....	.10	Sheep, per head.....	.05
Explosives, per ton.....	1.00	Pigs (50 pounds and under).....	.05
Lumber and lumber products:		Goats and dogs.....	.10
Lumber, per 1,000 feet, board measure..	.225	Chickens, crate measurement, per ton..	.20
Shingles, per bundle.....	.01	Dressed animals, per ton.....	.20
Laths, per bundle.....	.01	Automobiles:	
Fence posts, each.....	.005	Which leave wharf on own wheels—	
Ties, per 1,000 feet, board measure.....	.225	2,000 pounds and under, each.....	.50
Piles, up to 20 feet in length, each.....	.05	2,000 to 3,000 pounds, each.....	.75
Piles, 20 to 50 feet, each.....	.075	3,000 pounds and over, each.....	1.00
Piles, 50 feet and over, each.....	.10	Crated (or which do not leave wharf on own wheels) per ton.....	.20

¹ Rates apply per ton of 2,000 pounds weight, or 40 cubic feet measurement, whichever basis creates the greater revenue.

Outgoing freight (foreign).¹

Rates of toll:	Rate.	Rates of toll—Continued.	Rate.
Sugar, per ton.....	\$0.075	Bananas (20 bunches per ton), per ton..	\$0.075
Coffee, per ton.....	.075	General merchandise (everything not listed above), per ton.....	.15
Pineapples (canned), per ton.....	.075		
Fresh pineapples (crated), per ton.....	.075		

NOTE.—Ship stores, supplies, and bunker coal exempt of toll.

*Enter and intraisland freight.*¹

[One charge for use of wharves at point of shipment and discharge.]

Rates of toll:	Rate.	Live stock—Continued.	Rate.
General merchandise, per ton.....	\$0.10	Hogs, per head.....	\$0.05
Sugar, per ton.....	.05	Sheep, per head.....	.025
Coffee, per ton.....	.05	Pigs (50 pounds and under), per head...	.025
Pineapples, per ton.....	.05	Goats and dogs.....	.05
Bananas, per ton.....	.05	Chickens, crate measurement, per ton..	.10
Fertilizer, per ton.....	.05	Dressed animals, per ton.....	.10
Explosives, per ton.....	.50	Automobiles:	
Lumber and lumber products:		Which leave wharf on own wheels—	
Lumber, per 1,000 feet, board measure..	.11	2,000 pounds and under, each.....	.25
Shingles, per bundle.....	.005	2,000 to 3,000 pounds, each.....	.375
Laths, per bundle.....	.005	3,000 pounds and over, each.....	.50
Fenceposts, each.....	.0025	Crated or which do not leave wharf on	
Ties, per 1,000 feet, board measure.....	.11	own wheels, per ton.....	.10
Piles, up to 20 feet in length, each.....	.025	Minimum packages (100 pounds and under	
Piles, 20 to 50 feet each.....	.04	exempt):	
Piles, 50 feet and over, each.....	.05	101 to 500 pounds, each.....	.025
Firewood, per cord.....	.15	501 to 1,000 pounds, each.....	.05
Fresh fish, per ton.....	.40	1,001 and over, each.....	.10
Live stock:			
Cattle, horses, and mules, per head....	.25		
Colts and calves (under a year old), per			
head.....	.125		

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.

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.

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 words "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 two (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 two (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 two (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 can not therefore get out of the way.

These signals are not signals of vessels in distress and requiring assistance. Such signals are contained in article thirty-one.

ART. 5. A sailing vessel under way and any vessel being towed shall carry the same lights as are prescribed by article two 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 can not be fixed, these lights shall be kept at hand, lighted and ready for use; and shall, on 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 two (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 two (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 two (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 one (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 four (a) and article eleven, last paragraph.

Arr. 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 8 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 other steam vessels.

Arr. 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-round 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-round 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 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 two (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 one mile.

Every fishing vessel of one hundred and fifty feet in length or upward, when at anchor, shall exhibit a white light visible all around the horizon at a distance of at least one mile, and shall exhibit a second light as provided for vessels of such length by article eleven.

Should any such vessel, whether under one hundred and fifty feet in length or of one hundred and fifty 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 rain storms make the signal prescribed for a vessel at anchor. (See subdivision (d) and the last paragraph of article fifteen.)

(i) In fog, mist, falling snow, or heavy rain storms drift-net vessels attached to their nets, and vessels when trawling, dredging, or fishing with any kind of drag net, 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 four (a) and the last paragraph of article eleven.

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 be not 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 four (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 can not 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 adapted by shipowners, 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 where 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 rain storms, 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 closehauled.

(b) A vessel which is closehauled on the port tack shall keep out of the way of a vessel which is closehauled 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 also 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 can not 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 twenty-seven and twenty-nine.]

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 that 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 can not 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 constructing 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.

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.				Air temperature.						Average relative humidity.	Average amount of clouds, 0-10.	Precipitation.			Wind.										Number of days gales 40 miles or over.	Number of days of fog.						
	Mean.	Extremes.			Mean.			Extremes.					Average fall.	Number of days 0.01 inch or more.	Maximum fall in 24 hours.	Average hourly velocity.	Highest velocity.	Average number of times (observations at 8 a. m. and 8 p. m.) from—															
		For month.	Highest.	Lowest.	Range.	For month.	Mean maximum.	Mean minimum.	Range.	Highest.								Lowest.	Range.	N.	NE.	E.	SE.	S.	SW.			W.	NW.	Calm.			
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	2	2	2	2	2	2	0.7	0
February.....	30.05	30.32	29.63	0.69	70.7	75.9	65.6	10.3	84	56	28	72	4.8	3.75	11	3.46	8.0	48	5	21	15	2	2	3	2	2	2	2	2	2	0.3	0	
March.....	30.05	30.24	29.68	0.56	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	2	0.2	0		
April.....	30.06	30.25	29.77	0.48	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	1	0.1	0		
May.....	30.03	30.20	29.80	0.40	74.6	79.6	69.6	10.0	85	63	22	68	5.2	1.74	12	1.94	8.5	48	2	30	21	3	1	1	2	1	1	1	1	0.0	0		
June.....	30.03	30.18	29.84	0.34	76.2	81.0	71.4	9.6	86	66	20	68	4.9	.92	13	3.07	8.5	40	1	28	26	2	1	1	0	1	0	0	0.0	0			
July.....	30.02	30.15	29.82	0.33	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	0.0	0			
August.....	30.01	30.16	29.86	0.30	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	1	0	0.0	0		
September.....	30.00	30.15	29.82	0.33	78.0	83.0	73.0	10.0	87	68	19	68	5.0	1.23	13	2.70	7.7	32	1	28	27	2	0	0	1	0	1	0	0.0	0			
October.....	30.00	30.17	29.78	0.39	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	1	0.0	0			
November.....	30.03	30.16	29.75	0.41	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	1	0.0	0			
December.....	30.01	30.28	29.51	0.77	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	0.2	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				

HAWAIIAN ISLANDS.

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