of cultivated land. The cliffs are characteristic of Koolau Range from behind Kaneohe Bay to rugged Makapuu Head.

Mokolea Rock, 20 feet high, is a mile off the southeast side of Mokapu Peninsula; the small, black rock has depths of 5 to 8 fathoms around it.

Kailua Bay, south of Mokapu Peninsula, is an open bight which affords no shelter from the trades. The northern part of the bay is free of the usual fringing reefs, and there is a sand beach at the head of the bay.

Alala Point, on the south side of Kailua Bay, is a low bluff with a 25-foot white stone monument that resembles a lighthouse.

Mokulua Islands, 0.7 mile from shore and midway between Mokapu Peninsula and Makapuu Head, are steep, rocky, and grass-covered. Elevations are 206 feet for the northern islet and 182 feet for the southern islet. On the shore side of the islets is an extensive reef; between the reef and the shore is a small-boat passage that leads to private landings.

Chart 4131.—Wailea Point, 5 miles northwest of Makapuu Head, is the northwest point of Waimanalo Bay. An airfield occupies a large area south of the point.

Waimanalo Bay, between Wailea Point and Makapuu Head, affords all-weather shelter for small craft behind the barrier reefs which parallel much of the bay's shore. A 2-mile stretch off midbay has no fringing coral reef; in the southern part the reef gets closer to shore and disappears near Makapuu Head. Depths of 10 feet can be carried into the bay except during strong trades when the entrance is closed by breakers. **Waimanalo** (1960 pop. 3,011; P.O.) is on the coastal highway that skirts the head of the bay.

Manana Island, 361 feet high, is a mile north-northwest of Makapuu Point Light. The island is part of an old crater and has a lighter shade of rock than any other in the vicinity. The sides are bluff except on the west where there is a short sloping point. The water is deep on the seaward side of Manana Island, and there are depths of 4 fathoms between the island and the mainland; the 4-fathom passage is not recommended for strangers.

Kaohikaipu Island, 80 feet high, is a flat, black mass of rock midway between Manana Island and Makapuu Head. A double rock, 10 feet high, is 200 yards northeast of Kaohikaipu, and a small black rock, barely above water, is about the same distance southwest of the island. There are depths of 5 fathoms between Manana and Kaohikaipu but passage is not recommended for straugers because of the reefs that make off from both islands. Depths are 4 to 6 fathoms in the bight between Kaohikaipu Island and Makapuu Head; passage is not recommended.

Chart 4117.—Kauai Channel, northwest of Oahu, is wide, deep, and clear. During the trades the current usually sets westward across the channel and divides at Kauai, part following the north side of the island and the other part following the south side. Strong southerly or southwesterly winds cause the current to set in the opposite direction to that produced by the trades.

KAUAI ISLAND (Chart 4100), 63 miles northwestward across Kauai Channel from Oahu, has an area of 553 square statute miles and is fourth largest of the eight major islands. Kauai measures 29 nautical miles east-west by 23 miles north-south and slopes from centrally located **Kawaikini,** a 5,170-foot peak. **Lihue** (1960 pop. 3,908; P.O.), the seat of Kauai County, is 2 miles inland from the east-coast port of Nawiliwili.

The mountains on the west and north sides of Kauai descend in steep, jagged ridges; the gentle slopes on the east and south sides are cut by numerous gulches. The peaks are nearly always cloud-covered, making them difficut to see from auy great distance. Dome-shaped **Haupu,** 2,280 feet high, is prominent in the southeastern part of the island. The entire northwest coast is backed by high bluffs; the rest of the coast is mostly low and rocky with some scattered sand beaches. A low coastal plain extends westward from the town of Waimea. The few outlying dangers can be avoided by giving the coast a berth of 2 miles.

Harbors and ports.—Nawiliwili, on the east coast, and Port Allen, on the south coast, are the only commercial harbors on Kauai and are the only places that afford shelter in almost all weather.

Currents.—The oceanic currents in the vicinity of Kauai generally follow the winds. The available local information relative to currents is given in the discussions of the various localities.

Weather.—The trade winds divide on the easterly side of Kauai, part following the north coast and part the south coast, and uniting again some distance west of the island. On the west side, between Mana Point and Makaha Point, calm or light variable airs prevail. A moderate southwest wind is sometimes felt at Waimea Bay, while a strong east wind is blowing about 2 miles offshore. Along the northerly and southerly shores the early morning trade wind is usually light until about 0900, and again decreases in strength about 1600. Occasionally kona winds, starting in the southeast, displace the normal trades; this coudition occurs more often during the winter months.

The east and north, or windward, sides of the island are noted for their heavy rainfall, which reaches a maximum yearly average of more than 400 inches on **Mount Waialeale.** The lower slopes have much less rain, and along the southerly side the fall seldom exceeds 20 inches. The winter months, from December to March, produce the strongest winds, which sometimes reach gale force and are accompanied by more rain than is usual at other times of the year.

Supplies and repairs.—Food supplies are obtainable at the various towns on the island, particularly at Lihue, the county seat. Ship chandlery is limited to small-craft requirements and occasionally must be ordered from Hono-

lulu. Fuel and water are available at Nawiliwili and Port Allen; limited bunker oil is available at Port Allen. The island has no repair facilities for medium or large vessels but minor repairs can be made at Port Allen. Small vessels can be hauled out at Nawiliwili. Some of the plantations have shops capable of handling small machine repairs.

Communications.—Port Allen and Nawiliwili are ports for a few interisland barges and transpacific vessels. Interisland passenger traffic is by air. Radiotelephone communication is available to the other islands and to the mainland. A good highway skirts the island except on the northwest side.

Chart 4111.—Nawiliwili Bay, on the southeast side of Kauai, has an entrance width of 0.8 mile between Carter and Ninini Points and an inland extent of about a mile. **Nawiliwili,** on the north side of the bay, is one of the two commercial deepwater ports on Kauai and is protected by a breakwater extending northeastward from Carter Point and by a jetty in the inner harbor. Southeast winds produce some surge but the harbor is otherwise secure.

Prominent features.—The shore consists of rocky bluffs, except at the mouth of Huleia Stream and in the vicinity of Nawiliwili. The jagged, mountainous coast extending southwestward from the bay is in marked contrast with the lowlands of Huleia Stream, on the southwest side of the bay, and affords a means of fixing the entrance from well offshore. A water tank on the wharf and a large white bulk sugar warehouse on the hill overlooking the wharf are conspicuous.

Ninini Point, on the north side of the entrance, is low, flat, and rocky, and is backed by land planted in cane. A rocky ledge with a depth of 12 feet at the outer end extends about 100 yards southward of the point. **Nawiliwili Harbor Light (21°57.5′ N., 159°20.3′ W.),** 118 feet above the water, is shown from an 86-foot buff-colored cylindrical concrete tower on the point. The loom of the light is frequently seen by vessels 40 miles away.

Kukii Point, 0.7 mile westward of Ninini Point and the north entrance point of the inner harbor, is a high bluff with a low, rocky shelf at the base. There is a light on the point.

Carter Point, on the south side of the eutrance to Nawiliwili Bay, is rocky and rises rapidly to **Kalanipuu,** which is 758 feet high; the hill is marked by an aviation obstruction light. The mountain spur that extends inland rises to Haupu, the most prominent feature of southeastern Kauai.

Kawai Point, 0.5 mile south of Carter Point, is a bold rocky headland, 525 feet high, very irregular and jagged in appearance.

Channels.—A Federal project provides for an entrance channel 40 feet deep to a harbor basin 35 feet deep. The channel and basin are maintained at or near project depths; markers include lights, and lighted and unlighted buoys.

Anchorage with some protection from the trades can be found between Ninini and Kukii Points, outside the breakwater, although it is reported that the holding ground is poor. Small boats can find excellent anchorage in **Huleia Stream,** except when the sandbar at the mouth closes the entrance. The stream which empties into the southwesterly end of the bay is navigable for small craft only at high water to the first footbridge, about 2 miles above the entrance, where a dam obstructs further passage. Small boats sometimes anchor in the bight between Ninini Point and the seawall north of the jetty. The bottom is sand and coral and there is a sand beach at the head of the bight.

Caution when entering.—The reverse turn, first around the breakwater and then around the seawall, which must be made when approaching the wharf, is difficult for large vessels in all but calm weather, and the assistance of a tug is usually needed. Vessels are sometimes required to drop anchor before warping alongside. The harbor has little surge.

Tide.—The diurnal range of tide is 1.8 feet at Nawiliwili.

Weather.—See Appendix for Nawiliwili **storm warning displays** and for **Lihue climatological table.**

Pilotage is compulsory for all foreign vessels and for U.S. commercial vessels under register in the foreign trade. Pilotage is optional for coastwise vessels who have on board a pilot licensed by the Federal government.

Towage.—A 300-H.P. tug and launches for handling lines are available. The assistance of the tug is usually necessary when approaching or leaving the wharf.

Quarantine.—The quarantine officer usually boards at the dock. The U.S. Public Health Serivce maintains an outpatient office at Lihue.

Customs.—A customs officer from Port Allen usually attends vessels on arrival at the dock.

Immigration matters are arranged through the office at Honolulu.

Harbor regulations.—These are established by the Harbors Division of the Hawaii Department of Transportation and enforced by the harbormaster who is also the pilot.

Wharves.—The State-owned pier provides cargo sheds and 990 feet of berthing space. State-owned pipelines are available for molasses, liquid fertilizer, and petroleum products. Private facilities include bulk-handling equipment and storage area for sugar, molasses, liquid fertilizer, and petroleum products.

Supplies.—Gasoline, kerosene, fuel oil, and fresh water are piped to the wharf. Diesel fuel is available by truck in small quantities. Some provisions and supplies are available at Lihue. Ship chandlery is limited to items for small craft.

Repairs.—A boat lift in the harbor can handle vessels up to 65 feet in length; the yard has a small machine shop.

Kawelikoa Point, 4 miles southwest of Nawiliwili Bay, is a dark, rocky headland 687 feet high. The point is at the seaward end of a ridge which extends northward to Mount Haupu.

From abont 1.5 miles southwest of Kawelikoa Point to Hanapepe Bay, the coast is a series of low bluffs and beaches; the back country is mostly under cultivation, and the cane fields extend well up the slopes in some places.

★ (6662) **HAWAII—Kauai—Hanapepe Bay—Buoy temporarily moved.**—Hanapepe Bay Lighted Buoy 1 has been temporarily moved about 370 yards eastward and reestablished in 21°53'32.8" N., 159°35'42.3" W. for evaluation purposes. Mariners are requested to submit any comments concerning this change to Commander, Fourteenth Coast Guard District.

(N.M. 46/65.)

(L.N.M. 40, C.G., Honolulu, Oct. 6, 1965.)
C. & G.S. Charts 4108, 4100, 4117.
C.G. Light List, Vol. III, 1965, No. 3766.
C. & G.S. Coast Pilot 7, 1963, page 261.

★ (1482) **HAWAII—Kauai—Port Allen Harbor—Depths.**—The previously reported shoaling to 30 feet at M.L.L.W. in the fairways used by deep draft vessels in a portion of Port Allen Harbor no longer exists.

Approx. position: 21°54'02" N., 159°35'43" W.

(Supersedes N.M. 25(3229) 1963.)

(N.M. 11/65.)

(C. & G.S. CL–1773/64; BP–66074.)
C. & G.S. Chart 4108.
C. & G.S. Coast Pilot 7, 1963, page 261.

★ (5117) **HAWAII—Kauai—Hanapepe Bay—Buoy relocated.**—Hanapepe Bay Lighted Buoy 1, previously temporarily moved, has been permanently relocated in 21°53'32.8" N., 159°35'42.3" W. (approx.).

(See N.M. 46(6662) 1965.)

(N.M. 32/66.)

(L.N.M. 27, C.G., Honolulu, July 13, 1966.)
C. & G.S. Charts 4108, 4100, 4117.
C.G. Light List, Vol. III, 1965, No. 3766.
C. & G.S. Coast Pilot 7, 1963, page 261.

Makahuena Point, 7 miles southwest of Nawiliwili Bay, is the southern extremity of Kauai. The low, flat point has a rocky shore with bluffs 20 to 50 feet in height. The land near the point is sandy and rolling, and there are short stretches of sand beach both northeast and west of the point. **Makahuena Point Light (21°52.3′ N., 159°26.8′ W.),** 80 feet above the water, is shown from a 20-foot wide pyramidal concrete tower on the point. A 335-foot Loran tower on the point is conspicuous. The bottom slopes gradually to a depth of 7 fathoms about 0.5 mile off the point. Several reefs extend about 300 yards offshore between the point and Koloa Landing.

There is a conspicuous mill stack at **Koloa** (1960 pop. 1,426; P.O.), 2 miles inland from Makahuena Point. The stack is visible all along this coast except for the short distance where it is hidden by **Paa Cones,** which are on a long, low ridge that extends inland from the point.

Koloa Landing, 1.5 miles westward of Makahuena Point, has a walled-in landing slip that affords fair protection for small craft in trade-wind weather but is completely exposed to the south. Anchorage is available in depths of 12 fathoms, rocky bottom, about 400 yards south of the landing. A road leads inland to Koloa.

Kuhio Park is 0.5 mile west of Koloa Landing and on the shore road. There are several beach houses between the landing and the park.

Kukuiula Bay, 3 miles west of Makahuena Point, has an entrance width of 150 yards and an inland extent of 300 yards; considerable protection is afforded small craft except in southerly winds. There is a breakwater on the reef that extends from the southeastern point of the bay; the concrete wharf on the inner side of the breakwater can be lighted and is used for loading and unloading small craft. **Kukuiula** is a settlement at the head of the bay. A quarter mile west of Kukuiula is the **Spouting Horn,** a sea-water spout which is active even in smooth weather.

Lawai Bay, 3.5 miles west of Makahuena Point, has an entrance width of 300 yards and an inland extent of 0.2 mile; fair protection is afforded small craft except in southerly winds. The side shores of the bay are low and rocky but there is a wide sand beach at the head. A grass-topped rock, 70 feet high, stands at the upper edge of the sand on the west side of the bay.

Makaokahai Point, 4.6 miles westward of Makahuena Point, is easily recognized because of the several hills extending northward from it. One particularly prominent hill, 0.5 mile inland, is 436 feet high and well-rounded, has canefields on the lower slopes, and is evenly capped with trees. The first low hills on the point are the walls of a water-filled crater.

Lanipuao Rock, with 3 feet of water over it, is about 0.3 mile southeast of Makaokahai Point and is marked by a lighted buoy. Vessels should not attempt to pass northward of the buoy.

Chart 4108.—Wahiawa Bay, 2.8 miles westward of Makaokahai Point and 1 mile east of Port Allen, is 170 yards wide at the entrance and indents the coast about 0.2 mile. Excellent protection is afforded small craft in all but southerly winds. Boats anchor in depths of 5 to 10 feet, sandy bottom. The sides of the bay are rocky. The seas usually break over the shoal 100 yards off **Weli Point,** on the southeastern side of the bay.

Hanapepe Bay, midway along the south coast of Kauai, is the approach to **Port Allen.** The bay is about 0.6 mile wide and indents the coast about 0.4 mile. A breakwater protects the dock at Port Allen on the eastern side of the bay. The shores are low, rocky bluffs except at the head of the bay, where there is a sandy beach.

Local magnetic disturbance.—Differences of as much as 2¼° from normal variation have been observed at Hanapepe Bay.

Prominent features.—Hanapepe Bay Breakwater Light (21°54.0′ N., 159°35.6′ W.), 32 feet above the water, is shown from a white pyramidal concrete tower on the end of the breakwater. On the eastern side of the bay are several oil tanks and warehouses. A light is on low, flat, and rocky **Puolo Point** on the west side of the bay. An airport used only by small planes is back of the point. A mill stack and buildings are 2 miles east of Port Allen.

Channels.—A Federal project provides for 35-foot depths in entrance channel and harbor basin. Controlling depth in basin was 30 feet in May 1963. Channel markers include lighted and unlighted buoys.

A reef extends about 200 yards from the shore eastward of the inner end of the breakwater. In heavy weather breakers extend 350 yards offshore on the northwest side of the bay and 50 to 150 yards off the southeasterly side of Puolo Point.

Anchorage.—The usual anchorage off Port Allen is in depths of 9 fathoms, coral and sand bottom, about 0.5 mile southeastward of the breakwater light. This anchorage is just within the red sector of the light on Puolo Point. The harbor affords shelter for all craft in almost all weather, but may become congested. A small-craft harbor, protected by breakwaters, is about 100 yards north of the pier.

Tides and currents.—The diurnal range of tide is 1.7 feet at Port Allen. The prevailing current off Puolo Point is westerly.

Pilotage is compulsory for all foreign vessels and U.S. commercial vessels under register in the foreign trade. Pilotage is optional for coastwise vessels who have on board a pilot licensed by the Federal government. The pilot will board day or night about a mile off the entrance.

Towage.—A small 65-foot, 275 h.p. tug is available at the port.

Quarantine, Customs, and Immigration officials board vessels at the dock. Port Allen is a customs port of entry. There is a private hospital in the area.

Harbor regulations.—These are established by the Harbors Division of the Hawaii Department of Transportation and enforced by the harbormaster.

Wharves.—The State pier provides 600 feet of berthing space on each side with depths ranging from 24 to 35 feet. A transit shed on the wharf has 36,000 square feet of storage space. Public pipelines are on the wharf and private bulk handling and storage facilities for molasses, liquid fertilizer, and petroleum products are in the port.

Ships are required to drop an anchor when approach-

716-810 O-64—18

★ (5118) **HAWAII—Kauai Island—Kokole Point—Light changed.**—Kokole Point Light (21°59.0′ N., 159°45.5′ W. approx.) now shows *flashing white* every *4 seconds* of 300 candlepower.

(N.M. 32/66.)

(L.N.M. 27, C.G., Honolulu, July 13, 1966.)
C. & G.S. Charts 4100, 4117, 4102, 4180, 4001.
C.G. Light List, Vol. III, 1965, No. 3768.
C. & G.S. Coast Pilot 7, 1963, page 262.

See N/M 5-1967 P 552

ing the pier. This assists in maneuvering to a berth as well as getting away in an emergency. During and after strong trade winds some surge is experienced at the pier. This condition may require small and medium craft to cast off but does not interfere with the cargo handling of large vessels.

Supplies.—Fresh water and limited amounts of gasoline, fuel oil, and diesel fuel are supplied by tank truck. Groceries are available in the principal towns on the island. Marine hardware is limited to small-craft items.

Repairs.—Facilities for minor repairs to vessels are available.

Communications.—Port Allen has highway and telephone communication with other parts of the island and radiotelephone and air communication with the other islands of the group. The town is a port of call for interisland barge and transpacific vessels.

Chart 4114.—Kaumakani (1960 pop. 921; P.O.) is 2 miles northwest of Puolo Point and a half mile inland. A mill stack is prominent.

Robinson Landing, a mile northwest of Kaumakani, is a small-boat harbor with a dredged entrance that accommodates drafts of 2 to 4 feet. A stone wall has been built around the harbor edges, and a marine railway is available for hauling small craft.

Hoanuanu Bay, 2 miles northwest of Kaumakani, has depths of 2 to 3 fathoms and affords good protection from trade winds for small craft. The east side of the bay is rocky; the northwest side is a sand beach.

A breaking area extends 0.5 mile off **Poo Point,** which is on the northwest side of Hoanuanu Bay. A buoy is moored in 44 feet a mile off the point.

Waimea Bay, an open bight 3 miles northwest of Kaumakani, is the approach to **Waimea** (1960 pop. 1,312; P.O.), which is the place where Captain James Cook, R.N., made his first (January 1778) landing in the islands.

Good anchorage can be found in and off Waimea Bay during ordinary weather in depths of 3 to 20 fathoms, sand bottom. Small boats usually shift anchorage to Hoanuanu Bay for better protection when the trades are strong. Depths of 5 to 18 feet extend 0.3 mile from the shore of Waimea Bay. The Waimea pier has depths of 11 feet at its outer end but these could be changed by the wave action on the sand bottom. Small craft seldom use the pier because of the heavy swell. Groceries are available in limited quantities at Waimea, and the town has a hospital.

Waimea River, which empties into Waimea Bay along the east side of Waimea, is navigable only for pulling boats because of the bar across the mouth; the river descends from the mountains through the deepest gorge on this part of Kauai. The ruins of a Russian fort are on the east side of the river's mouth; the fort was built in 1815 and abandoned in 1817.

Between Waimea River and **Oomano Point,** 2.3 miles to the westward, a reef extends 0.4 mile from shore and breaks in heavy weather. **Kikiaola Boat Harbor,** 1.6 miles west of the river, is entered over the reef and is protected by breakwaters. The harbor has finger piers and a small marine railway; the entrance is marked by a range. The controlling depth is about 5 feet over the reef and in the basin.

Chart 4100.—A low plain, about 2 miles wide, extends westward from Waimea River around Kokole Point and northward to the Barking Sands beyond Nohili Point. Sugarcane is cultivated on most of this flat area. The shore side of the plain has a growth of algaroba trees, behind which are occasional sand dunes.

Kekaha (1960 pop. 2,082; P.O.) is a plantation settlement on the northwest side of Oomano Point and 2.5 miles from Waimea River.

Kokole Point, 5 miles west-northwestward of Waimea River, is low, rounding, and wooded. **Kokole Light (21°58.9′ N., 159°45.5′ W.),** 58 feet above the water, is shown from a 43-foot white pyramidal skeleton tower on the point.

Mana Point, about 3.5 miles northward of Kokole Point, is the westernmost extremity of the island. Along the water's edge is a strip of sand which extends 2 miles on either side of the point, but the sea breaks on a lava ledge at the edge of the sand, making the beaching of boats dangerous except when the sea is smooth.

Current observations taken during a 24-hour period 0.5 mile off Mana Point show a tidal current of 0.8 knot velocity at strength setting southward and northward along the coast. The southward maximum occurs about 3 hours after low water at Honolulu and the northward maximum 3 hours after high water. Similar observations taken near the coast about 3.5 miles southeastward of Nohili Point show a tidal current with velocities generally less than 0.5 knot.

Discolored water, caused by the drainage canals and the undertow from the beach, is often noted as far as 2 miles off Mana and Kokole Points. The village of **Mana,** 1 mile inland from the point, is marked by several large bushy trees and tall coconut palm trees. An aviation control tower at Bonham Air Force Base one mile southwest of Mana is prominent.

Nohili Point, about 6 miles northward of Kokole Point, is marked by **Nohili Dune,** 100 feet high, and the highest and southernmost of a chain of sand dunes extending along the coast for 2.5 miles to the northeastward. The dunes are known as **Barking Sands** and mark the northern limits of the cane fields. A road continues to Polihale.

A narrow sand shoal, with depths of 7 to 10 fathoms, extends from Nohili Point to **Alapii Point,** 7.5 miles to the northeastward. The shoal, which appears to be a succession of east-west sand ridges, lies 1 to 2 miles from shore. A depth of 3 fathoms is 0.5 mile west of Alapii Point; from there to Kailiu Point, 7 miles farther to the northeastward, the 15-fathom curve is at an average distance of 1 mile from shore.

From Barking Sands northeastward to Kailiu Point, the coast is rocky and precipitous. The section between Alapii and Kailiu Points consists of a series of cliffs known as **Napali.** These cliffs are 2,000 feet high in some places,

and are cut up by numerous streams which form small waterfalls. The southerly part of this section is practically bare, but the northerly part is wooded.

Kalalau Valley, 2.5 miles northeast of Alapii Point, is the broadest and deepest valley along the northwest coast and is easily distinguished from seaward.

Kailiu Point, on the north coast of Kauai, is the seaward end of a jagged ridge which ends abruptly in a sharp peak 1,200 feet high. There is a narrow strip of lowland at the point.

Chart 4118.—Haena Point, 1.2 miles east of Kailiu Point, is low and rounding. A reef, which bares at low water, extends 0.3 mile northwestward from the point. The **Haena Caves,** which cannot be seen from seaward, are 0.2 mile inland under the bold face of the mountains; the caves are near the western end of the highway which skirts the north shore of Kauai.

Wainiha Bay, 1.3 miles east of Haena Point, has an entrance width of 0.5 mile between the extensive **Kepuhi Point** reef on the west and **Kolokolo Point** on the east; inland extent is 0.4 mile. The bay is an open light which affords little protection except in kona weather. **Wainiha River** empties into the head of the bay from the most westerly of the deep valleys along the north coast of Kauai.

Lumahai River, which is unnavigable, empties into the sea on the east side of Kolokolo Point; east of the river mouth is a sandy beach with a few rocky patches. The river valley is the western limit of the many rice fields on the north side of Kauai.

Makahoa Point, 2 miles east-southeastward of Haena Point, is black and rocky. A half mile inland is Puu Ka Manu, a 714-foot hill.

Hanalei Bay has an entrance width of a mile between Makahoa Point on the west and the extensive Puu Poa Point reef on the northeast; inland extent is nearly a mile. Breaking coral reefs fringe the shores on both sides of the entrance. Seas break across the entire entrance during northerly or northwesterly gales but good protection is afforded from the easterly trades. Midbay anchorage is in depths of 6 fathoms, sandy bottom.

Along the sandy beach at the head of Hanalei Bay are clumps of ironwood and coconut trees and the houses of **Hanalei** (1960 pop. 370; P.O.). The highway is close to the shore. Three miles inland the mountains attain heights of more than 4,000 feet.

Hanalei River, which empties into the east side of the bay, is navigable for shallow-draft boats for a distance of 2 or 3 miles; at high water a depth of 4½ feet can be carried over the bar at the mouth. A clump of ironwood trees is prominent on the north side of the river's mouth. A wharf, with a depth of about 4 feet at the outer end, is on the eastern side of the bay and 200 yards south of the Hanalei River. The wharf is unsafe. A prominent large white luxury hotel and cottages are on the bluff on the north side of the river near the entrance.

Waioli Stream and **Waipa Stream,** which empty into the head of Hanalei Bay, are not navigable. Rice and taro are grown extensively along these streams and along Hanalei River.

Puu Poa Point, on the easterly side of Hanalei Bay, is a bluff about 50 feet high, back of which a green ridge extends inland.

From offshore the northerly side of Kauai presents a very irregular and jagged skyline, with ridges extending in all directions. 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, cut up by gulches, back of which a rolling plain extends to the mountains. Between the shore and the highway, 1 mile inland, are pineapple and sugarcane fields.

Kalihiwai Bay, 4.5 miles eastward of Hanalei Bay, is about 0.5 mile in diameter. **Pukamoe Point,** a red precipitous bluff about 150 feet high, is on the east side of the entrance. Several houses are scattered along the sand beach at the head of the bay, which is backed by a wooded gulch. Indifferent anchorage, with poor holding ground, can be found in depths of 5 fathoms in the center of the bay, but a heavy swell sets in during northerly winds. A rock awash lies 150 yards north of Pukamoe Point. A reef, 0.2 mile wide and bare at low water, fringes the shore for 2.5 miles westward from Kalihiwai Bay and vessels should stay at least 0.8 mile offshore. A shore road, with beach houses along it, extends westward from the bay for 1.5 miles.

Kilauea Point, the northern extremity of Kauai Island, is a grass-covered bluff about 165 feet high. **Kilauea Point Light (22°14.1′ N., 159°24.3′ W.),** 216 feet above the water, is shown from a 52-foot white conical concrete tower; a radiobeacon is at the light. **Mokuaeae Island,** 200 yards off Kilauea Point, is a black, flat, grass-topped rock about 200 yards in diameter and 92 feet high. The island is the most prominent feature in the vicinity to coasting vessels.

Kilauea (1960 pop. 665; P.O.), 1.3 miles inland from Kilauea Point, is not easily seen when close to shore. The sugar of the district is trucked to Nawiliwili for shipment.

Between Kilauea Point and Mokolea Point the coast is bluff, rising gradually from each point to an elevation of about 500 feet midway between them.

Makapili Rock, 0.8 mile southeast of Kilauea Point, is 156 feet high, black, and prominent. The rock is on the outer end of a narrow neck of land which juts out 200 yards from the general coastline.

Mokolea Point, 1.2 miles southeastward of Kilauea Point, is narrow, 140 feet high, and projects out 0.3 mile from the general coastline. The point is on the northwest side of Kilauea Bay and has two old buildings near its outer end.

Kilauea Bay has an entrance width of 0.5 mile and an inland extent of 0.5 mile. The bay is open to the trades but offers some protection in westerly weather. A narrow coral reef fringes the shore, and **Kilauea Stream** empties into the head of the bay. Anchorage can be found in depths of 6 fathoms, rocky bottom, near the center of the bay.

Low **Kepuhi Point** is 2 miles eastward of Mokolea Point. The low coast between the two points is fringed with a narrow coral reef.

Chart 4100.—Moloaa Bay, 4.5 miles southeast of Kilauea Point, has an entrance width of 0.3 mile and extends the same distauce inland to the mouth of a gulch. Little protection is afforded from the heavy swell that sets into the hay during the trades, but anchorage is possible during southerly winds in depths of 3 to 6 fathoms in midbay. There are a few houses along the sand beach at the head of the bay, and rice is grown in the gulch. The interior between Moloaa and Anahola Bays is used principally for pineapple cultivation and for grazing.

Papaa Bay, 6 miles southeast of Kilauea Point, is a small bight which is wide open to the trades. The central part of the bay is foul and there is a rock awash 300 yards from shore. A coral reef fringes the south shore.

Anahola Bay, 7.5 miles southeast of Kilauea Point, is a small bight exposed to the trades. **Kahala Point,** a low bluff with a grove of ironwood trees near the outer end, is on the southeast side of the bay. A light is shown from the point. A water tank a mile westward of the light is prominent. Discolored water frequently extends for a considerable distance off **Kuaehu Point,** on the northwest side of the bay. A reef extends about 0.3 mile from Kuaehu Point. Because of the numerous reefs, strangers should not attempt to enter the bay. In moderately smooth weather small vessels can find anchorage well inside the bay in depths of 4 to 6 fathoms, mud bottom.

Pinnacle Peak, 1.3 miles inland from Anahola Bay, is a tall, dark spire, with greeu slopes, that stands out more prominently than any other land feature ou this part of the island.

Between Kahala Point and Kealia are low coastal bluffs and a rocky shore with some patches of sand.

Kealia (P.O.), 3 miles southward of Kahala Point, is a plantation village. A short breakwater, extending southeastward from the shore, affords some protection from northerly weather for shallow-draft boats. The breakwater is not kept in repair, and portions have been carried away by the sea. Vessels should not approach the village without local knowledge. About 0.7 mile south of Kealia, a flat building on a low hill is prominent from offshore.

Kapaa (1960 pop. 3,439; P.O.), 5 miles southward of Kahala Point, is scattered along the beach. A reef, which is 0.3 mile wide in some places, extends alongshore from north of Kapaa to Hanamaulu Bay. An opening in the reef at Kapaa is usually marked by breakers on either side. Sampans find anchorage in depths of about 2 fathoms behind the reef and about 150 yards off the northern side of the village.

Wailua (1960 pop. 1,129) is a settlement at the mouth of **Wailua River,** which empties into small **Lehuawehe Bay** 6.5 miles southward of Kahala Point. The river, which is spanned by a bridge at its mouth, is navigable for small boats for several miles, once the shifting bar at the mouth is passed. Vessels may find unprotected anchorage off Wailua in depths of 10 to 15 fathoms, rocky bottom, but, like the whole northeast coast of the island, anchorage is not safe when the trade winds are blowing. **Waipouli** is a village 1 mile northeastward along the highway from Wailua.

Nonou, 1.3 miles northwestward of Wailua and 1,238 feet high, is the northernmost and highest of the low mountains near the coast.

Kalepa Ridge is 1 mile inland and parallels the coast from Wailua to Hanamaulu Bay. The southern end of the ridge, which is about 700 feet high, is marked by several buildings high on tbe seaward face of the bluff. The buildings can be seen for many miles offshore and are a good leading mark for Hanamaulu Bay.

Chart 4112.—Hanamaulu Bay, 10 miles southward of Kahala Point and 2.6 miles northward of Nawiliwili, is about 0.3 mile wide and indents the coast about 0.5 mile. **Ahukini Landing** is on the point on the south side of the entrance. Only the outer third of the bay has deep water; the sand and coral bottom slopes gradually from the 18-foot curve to the beach at the head of the bay. The shores of the bay are low, rocky bluffs, about 40 feet high, except for the white sand beach at the head. A fringe of trees on the bluffs forms a windbreak for the extensive cane fields on either side of the bay. **Hanamaulu Stream,** which empties into the head of the bay, is not navigable.

The 20-foot concrete tower of an abandoned lighthouse is on the outer end of the 300-foot stone breakwater which projects from the south point of Hanamaulu Bay entrance; a small wooden pier is at the inner end of the breakwater. The hay is no longer used by large vessels. Only the concrete piling remains of the former wharf at Ahukini Landing, and most of the port installations are in ruins. A heavy outside swell causes a heavy surge in the harbor.

Chart 4100.—From Hanamaulu Bay to Nawiliwili the coast is a series of low bluffs with occasional stretches of sand beach; there are no off-lying dangers. Sugarcane is grown extensively on the land back of the beach. An aero light at Lihue Airport is 0.7 mile south of Hanamaulu Bay.

Chart 4117.—Kaulakahi Channel, between Kauai and Niihau, is about 15 miles wide and clear of obstructions. Off Mana Point the trade wind following the south coast of Kauai meets the air current that has followed around the north side. The trades blow directly across the lowlands of Niihau, but part is deflected southward and around the sontheast point of the island.

Currents.—Little is kuown of the current in Kaulakahi Channel, but presumably it is variable depending mainly upon the velocity and direction of the wind. There appears to be a general northwestward flow along the southwest coast of Kauai. It is reported that a current sometimes sets southward along the east coast of Niihau at the same time that the current is setting northwestward along the Kauai coast. There are noticeable tidal currents near the western extremity of Kauai.

★ (5119) **HAWAII—Lehua Island—Light to be changed.**—About September 9, 1966, Lehua Rock Light (22°01.4′ N., 160° 06.0′ W. approx.) will be changed to show *flashing white* every *6 seconds* and intensity increased to 625 candlepower.

(N.M. 32/66.)

(L.N.M. 27, C.G., Honolulu, July 13, 1966.)
C. & G.S. Charts 4117, 4181, 4102, 4180, 4001.
C.G. Light List, Vol. III, 1963, No. 3769.
C. & G.S. Coast Pilot 7, 1963, page 265.

NIIHAU ISLAND (Chart 4117), 15 miles westward across Kaulakahi Channel from Kauai, is seventh in size and westernmost of the eight major islands. Niihau has an area of 72 square statute miles, a northeast-southwest length of 16 nautical miles, and an average width of 3.5 miles. Near the middle of the island is a high tableland with occasional rises or cones, the highest of which is 1,281-foot **Paniau.** The northerly and easterly ends of the tableland are precipitous and vary in height from 600 to 1,000 feet; the southerly and westerly slopes are gradual. A dirt road follows the west coast of Niihau for most of its length. The island has no streams.

The population of Niihau was 254 in 1960. One family owns the entire island and operates it as a cattle ranch. There is no scheduled communication with the island.

Lehua Island, about 0.6 mile off the north end of Niihau, is a small rocky, crescent-shaped island, with the crescent open to the northward. The easterly and westerly points are low, rising gradually to an elevation of about 700 feet near the center of the island. On the westerly point is a natural arch. **Lehua Rock Light (22°01.4′ N., 160°06.0′ W.),** 709 feet above the water and visible 12 miles, is shown from a white skeleton tower on the summit of Lehua Island.

Lehua Channel, between Niihau and Lehua, is restricted on its southerly side by rocks that show above water and extend about halfway across it. A depth of 7 fathoms can be carried through the channel by staying within about 350 yards of the Lehua shore. In heavy northwest weather the swell almost breaks in the passage, and as little is to be gained by using the channel, vessels should pass northward of Lehua Island. The current through the channel varies with the tide and sets in both directions with a velocity of about 1.5 knots.

To the eastward of Lehua Channel vessels should give the north coast of Niihau a berth of 0.5 mile; to the westward the clearance should be about 1 mile.

Puukole Point, on the north end of Niihau, is low, as is **Kikepa Point,** 1 mile to the eastward. Between these points and the high bluff on the northerly side of the tableland, the land is low and grass-covered, with a few low hills. From a distance this lowland is not visible and Lehua Island appears to be about 3.5 miles from Niihau.

Kaunuopou Point, 1.8 miles southeast of Kikepa Point, is the easternmost point of Niihau. **Kaunuopou Rocks,** over which the sea breaks, are 300 yards off the point. Another rock, about 0.4 mile off the southern side of the point, usually breaks and should be given a good berth by vessels approaching Kii Landing.

Kii Landing, in a small hight about 0.7 mile west of Kaunuopou Point, is only slightly protected from the trade winds. The landing is usable in ordinary weather, but not in southerly weather. The landing is built on beach boulders and has depths of only 2 or 3 feet alongside. Anchorage can be had in depths of about 8 fathoms, coral bottom, about 0.6 mile off the landing.

About 1.3 miles southward of Kii Landing a reef, with about 1 fathom of water over it and usually breaking, extends 0.5 mile offshore. The 10-fathom curve is about 1 mile offshore. From the vicinity of the reef to Pueo Point the coastline consists of cliffs reaching a height of 1,000 feet.

Pueo Point, 5 miles southward of Kaunuopou Point, is a prominent brown, precipitous bluff about 800 feet high. Southwestward from the point for a distance of about 4.5 miles the coastline consists of bluffs which gradually diminish in height toward the lowlands of the southern half of the island. The bluffs are broken by small hights, most of which have short sand or pebble beaches where boats could land during smooth weather. Beyond the bluffs to Kawaihoa Point, a distance of about 6 miles, the coast consists of a series of low bluffs about 15 feet high, with stretches of sand beach, a few sand dunes, and scattered trees. Between Pueo Point and Kawaihoa Point are no known outlying dangers, the few isolated rocks being very close to the shore.

The lowland of the southern part of the island is broken by two hills, one on Kawaihoa Point and the other, **Kawaewae,** a gently rounded hill 315 feet high, which is 4 miles north of the cape and 1.3 miles inland from the west coast.

Kawaihoa Point, the southernmost point of Niihau, is formed by a hill 548 feet high, the seaward face of which is steep. From a distance the hill has the appearance of an island and can easily be mistaken for Kaula Island. Deep water is close to the point. About 2 miles south of the cape there is a prevailing westerly current which reaches a velocity of about 1.5 knots.

Beyond Kawaihoa Point the coast gradually curves northwestward and northward and is low and rocky with occasional short sand beaches. At **Leahi Point,** 1.7 miles westward of Kawaihoa Point, the 10-fathom curve is 0.6 mile offshore. A dirt road skirts the western shore.

The coast between **Kamalino,** a former village 4 miles northwestward of Kawaihoa Point, and Puukole Point is practically one low, continuous beach, with an occasional group of rocks. Near the beach are numerous sand dunes covered with sparse vegetation. In the vicinity of Kamalino weak currents have been reported setting northward and southward along the coast.

Nonopapa Landing, 5.5 miles northwestward of Kawaihoa Point, is the principal landing on the island. Local vessels call occasionally for the island's cattle. The landing is used only from May to September, as there is often a heavy northerly swell during the winter months. The landing is marked by a shed and derrick on a short concrete retaining wall at the north end of a long sand beach. **Kaeo,** a cone 1,018 feet high and near the center of the tableland, shows on the skyline from the anchorage.

Anchorage is available in depths of 8 fathoms, coral and sand bottom, about 660 yards off the derrick, with the landing shed and Kaeo in range and bearing 070° Kawaewae is 1.5 miles 135° from the anchorage. The landing is somewhat protected by a small reef extending about 75 yards southwest from the end of the retaining wall. Small boats approaching the landing head south of it until the reef is rounded. **Puuwai,** the principal village of the island, is about 2.5 miles northeast of the landing.

Kuakumoku Rock, 1.6 miles northward of Nonopapa Landing, is a large, single rock about 4 feet above water

and near the center of a reef some 200 yards in diameter and 500 yards offshore. The reef should be given a berth of 0.5 mile, and only small craft should attempt the passage between the reef and the shore. Other reefs extend about 0.5 mile offshore 0.5 mile south and 3 miles northeast of Kuakumoku Rock.

Kaununui Point, 4.5 miles northeastward of Kuakumoku Rock, is marked by a group of rocks a few feet high and close to the shore. A coral reef with depths of 6¼ fathoms over it lies 1.5 miles off the point. It is reported that the reef breaks in heavy weather. The passage inside the reef is not recommended except for small boats.

Keawanui Bay is no more than a slight curve in the shoreline that extends northeastward from Kaununui Point for 3 miles. The bay has a sand and coral bottom and a sandy shore. A rock with 2 feet of water over it lies in the southern part of the bay, 0.8 mile northward of Kaununui Point, and 0.5 mile offshore.

From the northern side of the bay to Puukole Point the coast is foul for a distance of about a mile offshore. Vessels should give this section of the coast a berth of at least 1 mile. About 2 miles westward of Puukole Point and 0.9 mile offshore is a reef with reported depths of 12 feet over it. A mile southward of this reef and 0.8 mile offshore is a rock with 5 feet of water over it.

Kaula, 19 miles southwestward of Niihau, is a small bare, rocky islet, 550 feet high. Vessels have anchored close to both the south and east sides of Kaula in depths of about 20 fathoms, but as the islet is only 0.7 mile long, little protection is afforded. A rock with a least depth of 5 fathoms lies 3.8 miles 300° from the highest point of Kaula. A bank with depths of 30 to 40 fathoms extends 5 miles northwestward from the islet.

The **danger zone** of an aerial bombing and strafing target is centered on Kaula; **see 204.223, Chapter 2, for limits and regulations.**

OUTER ISLANDS (Chart 4000).—The small rocky islands, reefs, and atolls west-northwestward from Niihau form a well-defined chain. Between Niihau and Gardner Pinnacles, 480 miles distant, are several widely-separated high barren rocks; continuing westward are the coral reefs and atolls.

Atolls.—An atoll may comprise one or more low coral islands situated on a strip or ring of coral surrounding a central lagoon. Many of these atolls have openings in the coral ring which permit passage of small boats, and sometimes large vessels, to anchorage in the enclosed lagoon.

Reefs.—Successful navigation through or among coral reefs is often dependent upon the eye. They are always more plainly to be seen from the masthead than from the deck or bridge. The best observing conditions are with the sun high and behind the observer, and with the sea slightly ruffled; reefs are extremely difficult to distinguish if the sea is glassy calm.

Reefs with about 3 feet of water over them appear light brownish in color; those with a fathom or more appear light green, deepening to darker green and finally deep blue. Under favorable circumstances, a reef with depths of 3 or 4 fathoms over it can be seen from aloft for a considerable distance; in greater depths, the reef can only be seen when nearly over it. Polaroid glasses have been found of great help in navigating among reefs.

Vigias.—A vigia is an indication on a chart that a dangerous rock or shoal is thought to be near the spot indicated. Douhtful navigation and strong currents account for a large proportion of the vigias that encumber or have encumbered the charts of the Pacific Ocean. Phosphorescence, seaweed scum, and shoals of fish often resemble reefs and breakers so closely as to deceive the most experienced. Many vigias have been disproved by extensive investigation, but many others are still on the charts and remain a source of annoyance to the navigator.

Chart 4181.—Nihoa (23°03′ N., 161°55′ W.), a barren, rocky, and uninhabited island, is about 120 miles northwestward of Niihau. The island was discovered by Captain Douglas of the British vessel IPHIGENIA on April 13, 1790. The low, stone walls of ancient ceremonial sites still remain on the island, and many stone images and other evidence of past visitations have been removed to the Bishop Museum in Honolulu. The island is the resort of several species of sea birds.

Nihoa is about 0.8 mile long and 0.2 mile wide. The easterly, northerly, and westerly sides are high and precipitous; the southerly side is much lower and its slopes are more gradual. **Millers Peak,** 910 feet high and the highest point on the island, is near the northwesterly end. **Tanager Peak,** 874 feet high, is near the northeasterly end. The southeast and southwest sides of the island terminate at points on either side of **Adams Bay.** In the bay are three small bights, the westernmost having a sand beach while the shores of the other two are rocky ledges. There is deep water, close to all sides of the island.

The safest anchorages are between the 15- and 20-fathom curves westward and southwestward of the island, but the holding ground is poor. The middle cove of Adams Bay probably affords the best landing, but the surge is considerable and great care must be taken in landing anywhere on the island. During heavy northwesterly weather landing is very dangerous. A steep trail leads from the middle cove to the top of the bluff. At the foot of the bluff is a seepage of water which is not suitable for drinking purposes except in emergencies.

Currents.—The prevailing current sets westward in the vicinity of Nihoa Island. Current observations taken about 0.2 mile west of the island show a nontidal flow of about 0.2 knot setting west-southwest combined with a tidal current of nearly 0.5 knot at strength setting northward and southward. The northward strength of the tidal current occurs about 6 hours after the local transit of the moon and the southward strength at about the time of local transit. The velocity measured was nearly 2 knots and set southward.

Local magnetic disturbance.—Differences from normal variation of as much as 33° have been observed on Nihoa.

Nihoa is near the southwesterly end of a bank which

★ (3186) **HAWAII—French Frigate Shoals—East Island—Information.**—**East** Island (23°47′ N., 166°13′ W. approx.) is marked by towers.

(N.M. 25/64.)

(NAVBROCEANO HONO : RS 9558/64.)

C. & G.S. Charts 4171, 4172.

C. & G.S. Coast Pilot 7, 1963, page **267.**

is about 18 miles long in a northeast-southwest direction, 10 miles wide, and has depths of 14 to 36 fathoms. Another bank, the center of which is about 18 miles west by south from Nihoa, is about 14 miles long in an east-west direction, 9 miles wide, and has depths of 15 to 25 fathoms. A bank about 54 miles southeastward of Nihoa has a least depth of 32 fathoms; the two banks 57 and 70 miles westward have least depths of 29 and 33 fathoms, respectively. The edges of the banks slope steeply to much greater depths. A 9-fathom shoal is about 5 miles northwestward of the easterly bank.

Necker Island (23°34′ N., 164°42′ W.) is 158 miles west by north from Nihoa. It was discovered by La Perouse on November 1, 1786, and was annexed to Hawaii in 1895. The island, which might well be called a rock, is uninhabited, but, like Nihoa, shows unmistakable evidence of ancient habitation. It is the home of countless sea birds.

About 0.7 mile long and less than 0.2 mile wide, Necker Island is made up entirely of lava. There are four peaks or hills, one near each end and two between. The highest, **Summit Hill,** 277 feet high, is near the middle of the island. **Annexation Hill,** 249 feet high, at the southwestern end of the island, is separated from the other hills by a low saddle and, when seen from a distance, appears detached. There is a sparse growth of low brush on the upper slopes of the hills.

Northwest Cape, a rocky spur extending northward from the west end of the island, is joined to the rest of the island by a low isthmus over which the seas break in rough weather. On the west side of the cape is **West Cove,** and on the east side is **Shark Bay.** Off the east end of the island are several low, detached rocks. A depth of 5 fathoms has been reported 0.5 mile south of Necker Island where general depths are 10 to 12 fathoms.

Vessels can anchor in depths of about 12 fathoms 0.5 mile south of the southwest point of the island, but the island is so small that it affords little protection. West Cove and Shark Bay are the landing places, but there are times when it is impossible to land anywhere on the island. During heavy northwesterly weather landing at West Cove is very dangerous. Shark Bay, open to the northeast trades, is usually filled with breakers. At certain seasons of the year some water may be found in a small ravine on the southeastern side of the island. Small seepages of unpalatable water have been found on the island.

Tide.—The rise and fall of the tide is about 1 foot.

Currents.—The prevailing current sets westward, but countercurrents may be expected close to the island. Four days of current observations taken 0.2 mile west-northwest of the west end of Necker Island show a westward nontidal flow of about 0.5 knot, combined with a tidal current of about 0.8 knot at strength. Easterly trade winds prevailed during the observations.

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

Local magnetic disturbance.—Differences from the normal variation of as much as 22° have been observed on Necker Island.

Necker Island is near the northern end of a bank about 40 miles long in a northwest-southeast direction. The bank is about 15 miles wide and has depths of 8 to 23 fathoms. The sand and coral bottom is plainly visible. A 10-fathom shoal has been reported about 19 miles northeastward of Necker Island.

Charts 4171, 4172.—French Frigate Shoals, about 85 miles west by north from Necker Island, is a crescent-shaped atoll about 17 miles long in a north-northwest direction. It was discovered by La Perouse on November 6, 1786, the day after leaving Necker Island, and like that island, was annexed to Hawaii in 1895. The atoll consists of a coral reef with a number of small, bare, sand islets on it, and is flanked by a volcanic rock and numerous coral heads and reefs.

The crescent reef is double, and the outer and inner arcs bound a lagoon which is 1 to 6 miles wide. At its midpoint the windward reef lies about 8 miles from a line joining the tips of the crescent; the leeward reef is about 5 miles from this line. The windward reef is nearly continuous and can be plainly seen in the daytime for a considerable distance by vessels approaching from the north, east, or southeast. The sea practically always breaks over the reef, and the few times it is not breaking, the green shoal water inside the reef is seen in ample time to avoid danger. The bottom slopes uniformly from the reef to the 100-fathom curve 1 to 2 miles off, and there are no known dangers from north through east to south of the windward reef.

The leeward or inner reef, however, is broken in many places and, in normal weather is seldom marked by breakers. The lagoon between the reefs is foul with numerous coral heads.

A bank with depths of 8 to 20 fathoms extends about 8 miles westward from the midpoint of the inner reef, where it then drops off rapidly to great depths.

La Perouse Pinnacle (23°46′ N., 166°16′ W.), a volcanic rock about 60 yards long, 20 yards wide, and 122 feet high, lies about midway between the tips of the crescent and west of the leeward arc of the reef. The rock is so steep and rugged that it is almost inaccessible. From a distance its guano-coated outline resembles a brig under sail. A small detached lava rock about 9 feet high lies off the westerly side of the pinnacle. The points of the crescent reef, as indicated by the ends of the line of breakers, bear about 170° and 310° from La Perouse Pinnacle.

Shark Island, the northwesternmost of the sand islets, lies 6 miles northwest of La Perouse Pinnacle. A coral reef fringes the islet. **Tern Island,** about 2 miles east-northeastward of Shark Island, is marked by a Loran tower, a water tank, and an observation tower. A radiobeacon is on the island.

East Island, 3 miles east-northeast of La Perouse Pinnacle, is a low sand bar 600 yards long in a northwesterly direction and about 100 yards across. Reefs that are

awash most of the time extend a mile westward and 0.2 mile southward from the island; the southern reef seldom breaks. A coral head that sometimes breaks is 0.6 mile south of East Island. Northeast and east of the island are numerous coral heads and reefs.

The low, sandy islets between Tern Island and East Island are the nesting places of sea birds and turtles. Extreme caution must be exercised when navigating in the vicinity of these islets because of the numerous coral heads.

Channels.—The principal approach to Tern Island is through **Southwest Channel** which extends 1.5 miles southwestward from a basin at the west end of the island. The navigational aids that mark the channel are not charted because of the dangerous coral growth and the limited space in the turning basin. The channel is used exclusively by small craft of the U.S. Coast Guard.

Anchorages.—The best holding ground southwest of French Frigate Shoals is in depths of 13 to 15 fathoms, sand bottom; in lesser depths the bottom is mostly coral. There are no all-weather anchorages for large vessels, but the conformation of the reef is such that some protection can be found from choppy seas and ground swell. Small vessels can find good protection from most weather behind the shoals and coral heads.

Routes.—Vessels approaching French Frigate Shoals from the north, east, or southeast in the daytime should have no difficulty in picking out the outer reef from a considerable distance off. In clear weather, La Perouse Pinnacle is plainly visible from outside the reefs. From the south, the reef is not so easily seen. The sea may not break over the shoals, and although the bottom is plainly visible close in, the shoals might not be detected from a little distance. The 100-fathom curve is only about 0.5 mile from the shoals.

Currents.—A prevailing current sets westward in the vicinity of French Frigate Shoals, but variable currents have been noted. A southwestward current of 2 knots has been measured. A one-day series of half-hourly current observations taken 0.7 mile west of the southern end of the shoal during a period of small wind velocity shows practically no current.

Weather.—The northeast trades prevail throughout the year, but westerly blows can be expected during the winter months. The average wind velocity is 12 knots, with monthly averages of about 16 knots in December to 9.5 knots in August. Gales have been experienced in July and September. Occasional heavy showers of short duration cut visibility to about 2 miles.

Facilities.—A May 13, 1963, report from the USCGC IRONWOOD says of Tern Island, "A shipmaster would be hazarding his vessel to try to take it into this harbor. I recommend that the Coast Pilot emphasize as does Chart 4171 that small boats only should use this channel. I further recommend that any reference to logistic support available to vessels visiting Tern Island be deleted since this facility is small and unable to provide such services."

Chart 4182.—Brooks Banks and St. Rogatien Bank are a group of five coral banks situated between French Frigate Shoals and Gardner Pinnacles. The banks extend 50 miles in a northwesterly direction, have depths of 11 to 59 fathoms, and are separated by channels several miles wide and more than 100 fathoms deep. The largest of these banks lies 60 miles 305° from La Perouse Pinnacle, is about 12 miles in diameter, and has depths of 12 to 56 fathoms. The southeasternmost bank, the smallest in the group, is 27 miles 297° from La Perouse Pinnacle, is about 2 miles in diameter, and has depths of 28 fathoms. The northwesternmost bank is 75 miles 311° from La Perouse Pinnacle, is about 6 miles long and 4 miles wide, and has depths of 30 to 43 fathoms.

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

Currents.—The oceanic flow is variable, but usually sets westward. Sixty half-hourly current observations indicate a northwestward nontidal current of about 0.5 knot, combined with a tidal current of 0.8 knot at strength. The tidal current is somewhat rotary, turning clockwise. The largest velocity observed was nearly 1.5 knots setting westward.

Chart 4173.—Gardner Pinnacles (25°00′ N., 168°00′ W.) are 120 miles northwest of La Perouse Pinnacle. They were discovered by Captain Allen of the whaler MARO in June 1820. The pinnacles are a solid, volcanic rock islet, 190 feet high and about 200 yards in diameter, and a smaller rock about 100 yards from the northwest side of the larger. The rocks are barren of vegetation and are covered with guano, giving them a snow-capped appearance. The only off-lying dangers are a small rock just off the northwest side of the larger pinnacle and two 20-foot patches, one of which is about 100 yards south of the larger pinnacle and the other just north of the smaller pinnacle.

Anchorage can be had anywhere on the bank which surrounds the pinnacles, but there is no protection; in general, the holding ground is poor. In comparatively smooth weather, landings can be made just north of the bight on the west side of the larger pinnacle.

Currents.—Current observations taken at a number of locations in the vicinity of Gardner Pinnacles show a west-northwestward oceanic drift of about 0.2 knot combined with a rotary tidal current, turning clockwise, of 0.2 knot at strength. Velocities of about 2 knots setting west-southwest were measured during easterly winds.

Gardner Pinnacles lie near the northeastern side of a bank about 50 miles long, in a north-south direction, and about 20 miles wide near the northern end. The bank has depths of 10 to 25 fathoms, and the sand and coral bottom is plainly visible.

Chart 4182.—Raita Bank (25°32′ N., 169°28′ W.), lies about 85 miles 291° from Gardner Pinnacles. It was discovered in 1921 by the French schooner RAITA. The bank is about 20 miles long in a north-northeast direction and has a maximum width of about 10 miles. Depths range from 9 to 20 fathoms and the sand and coral bottom is plainly visible under ordinary weather conditions. At

the 20-fathom curve, the bottom drops off rapidly to great depths. In heavy weather, the swells seem to lump up slightly over the shoaler areas, but there are no dangers. Large schools of Ulua fish and sharks have been observed on the bank. Anchorage can be had on the bank in the open sea with fair holding ground.

Currents.—Variable currents are reported in the vicinity of Raita Bank. Current observations in the vicinity indicate a rotary tidal current turning clockwise.

Chart 4174.—Maro Reef (25°25′ N., 170°35′ W.), lies about 60 miles westward of Raita Bank. It was discovered by Captain Allen of the whaler MARO in June 1820. The large, oval-shaped, coral bank is about 31 miles long in a northwesterly direction and about 18 miles wide. The center of the bank is a large area of reefs awash. This broken area, about 12 miles long in a northwesterly direction and 5 miles wide, is extremely foul, with many coral heads awash and channels of deep water between. Only one very small rock, about 2 feet high and on the north side of the reef, shows above high water. Outside the broken portion of the reef, which is practically always marked by breakers, is the wide shelf of the bank with depths of 12 to 20 fathoms.

The bow of a T–2 tanker, stranded on the southwestern side of the reef, shows 54 feet above the water and is the only visible mark on the reef. Breakers, or the light blue-green color of the area within the broken portions of the reef, give the first warning of the proximity of danger. All maneuvering in the vicinity of the broken area must be done with extreme caution and with the sea and light such that shoal spots can be seen and avoided. Ordinarily, spots with less than 6 fathoms of water are plainly visible.

There are no dangers more than 2 miles from the general outline of broken portions of Maro Reef, thus leaving a navigable shelf with depths of 12 to 20 fathoms on all sides but the northeast where depths of 7 to 10 fathoms are found.

Vessels may anchor in the shelter of the broken portion of the reef on any side: the closer to the reef the more caution is necessary to avoid the isolated coral heads which can usnally be seen in favorable sunlight. Good shelter from the northeast trades can be had on the west side between two long arms of the reef which project, one to the northwest and one to the southwest, from the main reef area. Care must be taken to avoid the 5¾ fathom spot off the middle of the entrance and the 4¼ fatbom spot well inside. Vessels entering should keep within 0.5 mile of the southwest arm of the reef. However, unless the navigator is familiar with the area, he should remain as far as he can from the broken area on all sides and still obtain the desired shelter.

Currents.—In the vicinity of Maro Reef the prevailing current sets westward but variable currents have been noted. Over the bank a rotary tidal current, turning clockwise, has been reported.

Chart 4186.—Laysan Island (25°46′ N., 171°44′ W.), is a low sand island about 65 miles west-northwest of Maro Reef. The island is 1.6 miles long in a north-south direction, about 1 mile wide, and 45 feet in elevation at its highest point near the north end. In the center of the island is a salt-water lagoon about 0.9 mile long. The island is mostly white sand, although it is partly covered with low vines and grass. The island is marked by an ironwood tree which is close to the scattered ruins of a small building on the west side of the island. Water can be obtained hy digging shallow wells, and sea fowl, eggs, and fish are abundant. The island is uninhabited and is seldom visited.

A coral reef, a few hundred yards wide, fringes the island. About 0.3 mile off the western shore is a small, sharp rock, about 3 feet high. Coral heads, covered with 4 to 7 fathoms of water, are numerous in the area within 1 mile of the island. The sand and coral bottom can nsually be seen in depths less than 10 fathoms, and often in greater depths. When approaching closer than 1 mile, a sharp lookout must be maintained to detect the coral heads.

Vessels can anchor in depths of 8 to 15 fathoms 1 to 1.5 miles off the island on all sides, depending upon which side affords the best protection. During the trades, anchorage can be had 0.5 to 1 mile off the west side in depths of 8 to 15 fathoms, fair holding ground. Small craft drawing not over 12 feet can lie at anchor inside the reef and off the ironwood trees on the west side of the island, but this anchorage affords no protection from westerly winds. During northeasterly and southeasterly weather the best landing can be made off the ironwood trees on the west side of the island. A poor landing can be made near the northeasterly end of the island during light westerly winds. The summer months are the best for landing, as the northeast trades prevail during this period.

Currents.—A current velocity of about 1 knot and a rotary tidal current, turning clockwise, have been reported. The current is believed to depend to a great extent upon the wind.

Chart 4182.—Laysan Island is just southeastward of the center of a circular bank 14 miles in diameter, with depths of 9 to 23 fathoms, beyond which the water deepens rapidly.

Northampton Banks, unsurveyed banks with a least known depth of 17 fathoms, lie about 35 miles southwest of Laysan Island.

Chart 4186.—Lisianski Island (26°04′ N., 173°58′ W.), is a small, low, sandy island, about 120 miles westward of Laysan Island. Captain Lisianski, of the Russian ship NEVA, discovered the island on October 15, 1805, when his ship grounded on the reef and was nearly wrecked. The island is about 1.2 miles long in a north-northwest direction, 0.5 mile wide, and 20 feet in elevation at its highest point on the northeastern side. The shores are white sand except for two stretches of rock ledge at the waterline on the east side of the island. Behind the sand beach, the island is overgrown with vines

and bushes. Two coconut palm trees in the northeast part of the island are prominent from northward. Brackish water may be obtained by digging shallow wells. Sea fowl, eggs, fish, and turtles are abundant. The island is uninhabited and seldom visited. Visits should be made during the summer months, when the northeast trades prevail, but small-boat landings have been made on the east side of the island at other times.

A reef circles around to the sonthwestward from off the north side of the island. It is marked near its offshore end by a coral ledge which bares at times and over which the seas break. The southern end of this ledge is 1.7 miles 260° from the northern end of the island. About 0.5 mile southwestward of this point is another ledge which is marked by a breaker in most weather. Midway between these ledges or breakers is a passage leading to the lagoon between the island and the reef. The passage has an uneven bottom with depths of 11 to 22 feet. About 350 yards southwestward of the northern ledge is a small shoal with a depth of 3 feet over it. These shoal spots are easily seen and avoided by small boats making the passage into the lagoon, hut vessels should not enter without local knowledge. Once inside, anchorage can be had in depths of 3 to 6 fathoms, taking care to avoid the scattered coral heads with only a few feet of water over them. Landing can be made on the west side and south end of the island in all but southwesterly and westerly weather.

Neva Shoal, with innumerable coral ledges, extends about 8 miles southeastward from Lisianski Island. This reef, which is about 4 miles wide, has its western extremity about 4 miles south-southwestward of the island. The southerly end of the reef is usually marked by breakers, and many of the ledges break in almost all weather. The shoal has areas of deeper water between the ledges, and small boats can maneuver over many parts of the reef, but it must be avoided by larger vessels.

In addition to Neva Shoal, there are many coral heads with depths of 3 to 6 fathoms over them within 3 miles of all sides of the island. A small coral ledge, with an islet on it and nearly always marked by breakers, lies 2.7 miles 254° from the south end of the island. Between this ledge and the island are depths as great as 8 fathoms and a scattering of coral heads, some of which are nearly awash. The lagoon could be entered between this ledge and the ledge marking the south side of the previously described opening 1 mile northward. A 14-foot rock, about 1.5 miles north-northeastward of the island, is marked by breakers only during heavy weather. Under favorable conditions dangerous coral heads can be seen for several hundred yards.

Anchorage can be had in trade wind weather abont 3 miles west of the island in depths of 11 to 15 fathoms, sand and coral bottom, with the north end of the island bearing 080°. During southwest weather, vessels can find anchorage 3 to 4 miles east of the north end of the island in depths of 8 to 15 fathoms. Small boats can anchor in the lagoon, as described previously.

Vessels may approach to within 3 miles of Lisianski Island from the northward on courses between 270° and 090°. The island and Neva Shoal should be given a wide berth when passing southward of them, as the island is seldom seen from the southern limits of the shoal. Vessels approaching from the southwestward should keep about 5 miles westward of the meridian of the island until the island bears 090°, and then approach the anchorage.

Currents.—One-half day of current observations taken 3 miles west of Lisianski Island indicate a rotary tidal current, turning clockwise, of 0.8 knot velocity at strength. A prevailing northwestward current is reported in the vicinity of the island.

Chart 4183.—Lisianski Island and Neva Shoal lie just southeast of the center of a bank about 25 miles long in a northwesterly direction and about 15 miles wide. Outside the reefs, general depths on the bank are 9 to 47 fathoms.

Pioneer Bank (26°02′ N., 173°26′ W.), lies about 30 miles eastward of Lisianski Island. The bank is about 8 miles in diameter and soundings of 18 fathoms have been obtained near its center. No breakers or dangers were observed during a preliminary survey, but, as the least depth may not have been obtained, vessels should avoid the area.

An uusurveyed bank with least known depths of 30 fathoms is reported to he about 36 miles northwest of Lisianski Island.

Chart 4175.—Pearl and Hermes Reef, lying about 145 miles northwest of Lisianski Island, is an extensive oval-shaped atoll about 40 miles in circumference, 17 miles long in a northeasterly direction, and 9 miles wide. The reef was discovered on April 26, 1822, by the British whalers PEARL and HERMES, which were wrecked on the same night within 10 miles of each other. Within the outer reef is a lagoou in which are numerous coral reefs with deep water between. Two wrecks lie stranded on the eastern side of the reef. There are no known dangers outside the heavy breakers on the outer reef.

On the outer reef are several small islets, most of which are on the south side: the exception is **North Island.** There are also several sandbanks that are awash at high water. **Southeast Island (27°47′ N., 175°49′ W.)** is the largest of the group; five otber named islands are scattered along a 7-mile stretch to westward. The islands are uninhabited and are bare of shrubbery except for a few ironwood trees.

The 6-mile opening on the northwest side of the outer reef has depths of 1 to 6 feet between the numerous coral heads. The small-boat channel between Southeast Island and **Bird Island,** next islet to the westward, has a depth of 7 feet; the channel between Bird Island and **Sand Island** has 19 feet. Lagoon entrance or navigation are definitely not for the amateur.

Anchorage can be had off the western entrance to the lagoon in depths of 8 to 12 fathoms, or on the easterly side of the reef. Vessels have anchored midway between the southern entrances and about 0.6 mile off Bird Island in

★ (5120) **HAWAII — Midway Islands — Midway Channel — Buoys relocated.**—The following buoys, previously temporarily moved, have been permanently relocated as indicated:

(a) Midway Channel Buoy 3, in 28°11'47.3'' N., 177°21'19.0'' W.
(b) Midway Channel Buoy 7, in 28°11'59.1'' N., 177°21'17.8'' W.
(c) Midway Channel Lighted Buoy 9, in 28°12'15.5'' N., 177°21'18.2'' W.
(d) Midway Channel Lighted Buoy 12, in 28°12'23.3'' N., 177°21'13.0'' W.
(See N.M. 8(1209) 1966.)

(N.M. 32/66.)

(L.N.M. 27, C.G. Honolulu, July 13, 1966.)
C. & G.S. Chart 4188.
C.G. Light List, Vol. III, 1965. Nos. 3775, 3777, and page 273.
C. & G.S. Coast Pilot 7, 1963, page 271.

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★ (1209) **HAWAII—Midway Islands—Midway Channel—Buoys temporarily relocated.**—The following buoys, due to shoaling of the channel edge, have been temporarily moved and reestablished in the positions indicated:

(*a*) Midway Channel Buoy 3 in 28°11'47.3'' N., 177°21'19.0'' W.
(*b*) Midway Channel Buoy 7 in 28°11'59.1'' N., 177°21'17.8'' W.
(*c*) Midway Channel Lighted Buoy 9, in 28°12'15.5'' N., 177°21'18.2'' W.
(*d*) Midway Channel Lighted Buoy 12, in 28°12'23.3'' N., 177°21'13.0'' W.

(N.M. 8/66.)

(BS 5939/66.)
(L.N.M. 50, 51, C.G., Honolulu, Dec. 14, 21, 1965.)
C. & G.S. Chart 4188.
C.G. Light List, Vol. III, 1965, Nos. 3775, 3777 and page 273.
C. & G.S. Coast Pilot 7, 1963, page 271.

depths of 25 fathoms.

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

Chart 4183.—Salmon Bank. unsurveyed, lies about 60 miles southwestward from Southeast Island on Pearl and Hermes Reef. The least known depth on the bank is 30 fathoms.

Gambia Shoal, position doubtful, lies about 50 miles west-northwest of Southeast Island on Pearl and Hermes Reef. The shoal has a depth of 14 fathoms and the bottom can be plainly seen. About 25 miles northward of the chartered position of Gambia Shoal is a bank with a least known depth of 35 fathoms.

Charts 4185, 4188.—Midway Islands, 1,150 miles west-northwestward of Honolulu, were discovered in 1859 by Captain N. C. Brooks, an American shipmaster on the Hawaiian vessel GAMBIA; possession was taken on behalf of the United States on September 30, 1867, by Captain William Reynolds of the U.S.S. LACKAWANNA. The circular atoll is 6 miles in diameter and encloses two islands. The coral reef does not completely enclose the lagoon; there is a natural opening on the west side and another opening has been dredged on the south side. The reef rises abruptly from deep water and there are no offlying rocks or shoals; breakers mark all seaward sides of the reef. The enclosed islands have been leveled off to maximum heights of 12 feet. Numerous birds, especially albatross, nest on the islands and are sometimes a hazard to landing or departing airplanes.

The Midway Islands are within a naval defensive sea area and are not a part of Hawaii State. The establishing Executive order of February 14, 1941, says of Midway Islands:

The territorial waters between the extreme high-water marks in the 3-mile marine boundaries surrounding Midway Islands, in the Pacific Ocean, are hereby established and reserved as naval defensive sea area for purposes of national defense.

At no time shall any person, other than persons on public vessels of the United States, enter any of the naval defensive sea areas herein set apart and reserved, nor shall any vessel or other craft, other than public vessels of the United States, be navigated into any of said areas, unless authorized by the Secretary of the Navy.

Eastern Island, at the southeast end of the atoll, is triangular in shape, about 1.2 miles long, 6 to 12 feet high, and covered with trees, shrubbery, and course grass. Prominent from seaward are the high towers on the southeastern side of the island and a large rectangular-shaped building on the northwestern side. A dredged channel leads from westward to a basin on the northwestern side of the island.

Sand Island, on the southerly side of the atoll, is about 2 miles long in a northwesterly direction, and is composed of white coral sand. Prominent from offshore are the towers, tanks, and radio masts of the naval installations and a group of trees on the north side of the island. An aero light is in the north central part of the island.

Welles Harbor is the area inside the gap in the harrier reef on the west side of the atoll. The harbor was formerly used to a considerable extent as an anchorage by ships calling at Midway, but since the dredging of the ship channel and harhor between Sand and Eastern Islands, Welles Harbor is little used. Navigation in this area sbould not be attempted without local knowledge. The harbor is safe during the summer when the northeast trades blow steadily, but from October to April when gales are frequent with a rough westerly sea, the bar across the entrance breaks almost constantly. It is reported that vessels of not over 14-foot draft may cross the bar into Welles Harbor during smooth weather. There are no navigational aids and anchorage is not tenable in moderate to fresh winds. A depth of 6 feet may be taken from Welles Harbor to the main anchorage basin if a constant watch is maintained for coral heads.

Channels.—The dredged channel through the south reef leads to a basin on the east side of Sand Island, to a mooring basin northeast of Sand Island, and to the Eastern Island side channel. Entrance depth was 35 feet in 1958 but probably has been changed by shifting sands; **consult Naval authorities for latest controlling depths.** Entrance-channel markers include lighted and unlighted buoys and a **000° lighted range**; the Eastern Island channel is marked by buoys and by a **102° lighted range.**

Anchorages.—The established anchorage area is northeast of Sand Island. Outside anchorage is available in depths of 15 to 25 fathoms east of the main-channel sea buoy; this anchorage is fair during northeasterly winds but should not be attempted during winds from other quadrants. Anchorage south of Sand Island is prohibited to avoid possible fouling of the San Francisco-Honolulu-Midway-Guam-Manila cable.

Routes.—Vessels approaching Midway Islands are warned that the islands and surrounding waters out to the 3-mile limit are restricted. In approaching from any direction vessels will remain 3 miles off until south of the entrance. They should then steer a northerly course heading directly hetween Sand and Eastern Islands until the channel is made out, then steer on the range. Due to the prevailing easterly winds and westerly set of current, caution must be exercised in entering. Drift and leeway should be anticipated and sufficient speed should he maintained at all times to control the vessel. See discussion of currents in the channel.

Tides.—The diurnal range of tide is 1.2 feet at Midway Islands. The generally calm waters inside the reef are occasionally subjected to strong surge and they can be extremely agitated by winter gales.

Currents.—The current off the main entrance channel usually sets to the westward, and is normally 0.2 to 1 knot. At the channel entrance the current sets southeastward, while in the channel it sets southward with a velocity of 2 to 6 knots. There is generally little current in Welles Harbor and it usually sets westward; it is reported that during heavy gales the harbor is full of strong currents caused by the sea being forced over the reefs.

water connections; depths alongside are 36 feet. In the submarine basin on the east side of Sand Island there is one pier with fuel and water connections; depths up to 30 feet are alongside. (7–271/63)

Line 42/L; read:

Repairs.—Limited repairs can be made to vessels, but there are no drydocking facilities.

Page 272.—Lines 20–22/L; read: incoming vessels south of the entrance. Commercial vessels are required to have a pilot and navy vessels not operating locally are requested to take a pilot. (7–271/63)

★ (2691) **HAWAII—Kure Island—Green Island—Buoy established.**—Kure Island—Green Island—Buoy discontinued.—Kure Island Fuel Line Marker Buoy 1 has been discontinued.

Approx. position: 28°22′56″ N., 178°18′38″ W.

(Supersedes N.M. 28(3612) 1964.)

(N.M. 19/65.)

(L.N.M. 14, C.G., Honolulu, Apr. 14, 1965.)
C. & G.S. Charts 4177, 4185.
C.G. Light List, Vol. III, 1964, page 274.
C. & G.S. Coast Pilot 7, 1963, page 272.

Weather.—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, continuing through July and August. Southwest winds are always accompanied with a low barometer, rain, and squalls. Rain also comes occasionally 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. Occasionally a few days of fine weather will prevail but a rough westerly sea is always present.

Harbor regulations.—Vessels approaching Midway identify themselves with the Naval station signal tower, Sand Island. All vessels must await positive permission from the tower to enter or leave the harbor. Entry is prohibited during the hours of darkness. Pilots will board incoming vessels south of the entrance. No vessel except those operating locally from Midway will enter the channel without pilots.

The following harbor control signals are displayed from the Naval station signal tower on Sand Island:

One ball.—Channel open for entering.

One cone, point up.—Channel open for leaving.

One ball over a cone, point up.—Channel closed.

Two cones, points together.—Channel open for two-way traffic.

Wharves.—At the northeastern end of Sand Island are two piers which have fuel and water connections, with depths of 36 feet alongside. In the submarine basin on the east side of Sand Island is a pier with a depth of 30 feet alongside. There is also a small-boat pier in the basin on the northwest side of Eastern Island. Twenty-ton mobile cranes, tugs, barges, and launches are available.

Supplies.—Provisions are available. Fuel oil, diesel oil, and water are not available for commercial use, except in case of emergency. Limited medical facilities are available.

Repairs.—Repairs can be made to small vessels.

Communications.—Telephone, teletype, radio, and cable systems are operated.

Chart 4185.—Unsurveyed **Nero Bank,** with a least known depth of 62 fathoms, is about 30 miles west-southwestward from Midway Islands. Westward from Nero Bank is **Pogy Bank,** also unsurveyed and with a least known depth of 41 fathoms.

Chart 4177.—Kure Island (28°25′ N., 178°20′ W.) is 50 miles west-northwestward of Midway Islands which it closely resembles both in formation and appearance. The Kure atoll is 4.5 miles in diameter, and a nearly continuous coral reef encloses a lagoon in which reefs and coral beads alternate with deep water. A mile-wide break in the southwest side of the barrier reef provides an entrauce of sorts to the lagoon.

Green Island, on the sontheastern side of the barrier reef, has a highest elevation of 20 feet; a tall, skeleton tower stands on the northeastern part of the island. West of Green Island are several small islets, largest of which is 10-foot-high **Sand Island.** The chart indicates possible landing on Green Island through a break in the reef at the southwest end; depths off landing are 5 to 6 feet between small coral heads and ledges.

The best anchorage is on the westerly side, near the northwesterly point of the breakers, in depths of 8 to 12 fathoms, rocky bottom. Vessels have anchored about 0.5 mile south-southwest of the south tip of Green Island in depths of 15 **fathoms,** sand and coral bottom. A bank with depths of **20 to 30** fathoms surrounds Kure Island. No dangers have been observed outside the reef. 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.

Currents.—A set to the southward has been observed between Kure Island and Midway Islands. In the vicinity of Knre Island a continuous eastward current of abont 2 knots during westerly weather has been reported.

Chart 4183.—Bensaleux Reef (26°18′ N., 178°44′ W.), was reported in 1920 by the master of the American steamer BENSALEUX to be about 127 miles southward of Kure Island. Breakers appeared to be about 0.5 mile in extent in an east-west direction and indicated the existence of a reef. About 65 miles southeast of Bensaleux Reef, breakers were observed in latitude 25°23′ N., longitude 178°04′ W., by the American Steamer ETHAN ALLEN in 1923. Tbe master reported that the swell appeared to mount up and occasionally break as though over a shoal extending for about 2 or 3 miles in an east-west direction.

Johnston Island, Schjetman Reef, Wilder Shoal, Kingman Reef, and Palmyra Island.—Descriptions of these outlying Pacific areas have been transferred from United States Coast Pilot 7 to the U.S. Navy's H.O. Publication No. 80, Sailing Directions for the Pacific Islands, Volume III, Eastern Groups.

APPENDIX

COAST AND GEODETIC SURVEY.—United States Coast Pilots, Tide Tables, Tidal Current Tables, and Tidal Current Charts: For sale by U.S. Coast and Geodetic Survey, Washington, D.C., 20230, and its district offices and sales agencies which are listed semiannually in the Notice to Mariners.

United States Coast Pilots:

1. Atlantic Coast, Eastport to Cape Cod, 1960.
2. Atlantic Coast, Cape Cod to Saudy Hook, 1960.
3. Atlantic Coast, Saudy Hook to Cape Henry, 1961.
4. Atlantic Coast, Cape Henry to Key West, 1959.
5. Atlautic Coast—Gulf of Mexico, Puerto Rico, and Virgin Islands, 1962.
7. Pacific Coast—California, Oregon, Washington and Hawaii, 1963.
8. Pacific Coast, Alaska—Dixon Entrance to Cape Spencer, 1962.
9. Alaska, Cape Spencer to Arctic Ocean, 1954.

Distances Betweeu United States Ports, Third (1961) Edition.

A Coast Pilot for which a supplement has heen issued should not be used except with reference to the latest issue of its supplemeut. Supplements may be obtained from the U.S. Coast and Geodetic Survey, Washington, D.C., 20230, or auy of its district offices.

Tide Tables:

Europe and West Coast of Africa.
East Coast, North and South America.
West Coast, North and South America.
Central and Western Pacific Ocean and Indian Ocean.

Tidal Current Tables:

Atlantic Coast, North America.
Pacific Coast, North America and Asia.

Tidal Current Charts:

Boston Harbor.
Narragansett Bay to Nantucket Sound.
Narragansett Bay.
Long Island Sound and Block Island Sound.
New York Harbor.
Delaware Bay and River.
San Francisco Bay.
Puget Sound, Northern Part.
Puget Sound, Southern Part.

District Offices.—Los Angeles District, 535 Subway Terminal Building, 417 South Hill St., Los Angeles 13, Calif. The Los Angeles District includes all of the State of Arizona; Clark County, Nev., and the following counties of California: San Bernardino, Kern, Santa Barbara, Ventura, Los Angeles, Orauge, Riverside, San Diego, and Imperial.

San Francisco District, Room 121, Customhouse, San Francisco 26, Calif. The district includes all the State of Utah, and the parts of Nevada and California not assigned to the Los Angeles District.

Portland District, Room 314, U.S. Courthouse, Portland 5, Oreg. The district includes all the States of Montana, Idaho, and Oregon; and the following counties of Washington adjacent to the Columhia and Snake Rivers: Wahkiakum, Cowlitz, Clark, Skamania, Klickitat, Benton, Franklin, Walla Walla, Columhia, Garfield and Asotin.

Seattle District, Room 705, Federal Office Building, Seattle 4, Wash. The district includes the State of Washingtou except for those counties assigned to the Portland District, and the State of Alaska.

Honolulu District, Room 244, Federal Office Building, Honolulu 12, Hawaii. The district inclndes the State of Hawaii and the U.S.-owned Pacific Islands, as well as those administered under the United Nations mandate.

Coast and Geodetic Survey Sales Agents.—Agents marked with an (*) asterisk also handle certain U.S. Naval Oceanographic Office publications, and those marked with a (†) dagger also handle certain U.S. Coast Guard publications.

California:

Alameda: Pacific Mariua Chandlery, Pacific Marina.
Arcadia: The Brown Shop, 49 East Huntington Drive.
Berkeley: Brennan Supply Co., 805 University Ave.
Bethel Island: Trogan Delta Boat Sales, Inc.
Bodega: McCaughey Bros.
Crescent City: Nielsen Hardware & Electric Co., Third and Eye Sts.
Eureka: †C.O. Lincoln & Co., 615 Fifth St.
Fairfield: Glenn & Red's Bait Shop, 1461 West Texas St.
Long Beach: B & B Supply Co., 1845 West Anaheim St.; Bahia Marine Hardware, 6200 East Pacific Coast Highway; *Long Beach Marine Hardware, 251 Marina Drive.
Los Angeles: C&GS, 535 Subway Terminal Bldg., 417 South Hill St.; Airport Marina, 5901 West Century; California Map Centre, 1100 South Hope St.
Lynwood: Pacific Coast Map Service, 12021 Long Beach Blvd.
Monterey, †Cincotta Brothers, 203 Alvarado St.

Morro Bay: Hortons, P.O. Box 635.
Moss Landing: Moss Landing Marine Supply, P.O. Box 55.
Newport Beach: Balboa Marine Hardware Co., 2537 West Coast Highway; *Newport Supply Co., 2700 West Coast Highway; *†South Coast Co., 23d at Central Ave.
North Hollywood: *†Pan-American Navigation Service, 12021 Ventura Blvd.
Oakland: Dick Peterson Co., 1363 Embarcadero.
Oxnard: Oxnard Sporting Goods, 235 West Fifth St.
Palo Alto: Glover Motor & Marine, 3705 El Camino Real.
Pittsburg: Seeno Bros. Boat Shop, 5 Cutter St.
Redondo Beach: Redondo Trading Post Co., 114 Diamond St.
Sacramento: A–1 Map Center, 3271 Folsom Blvd.; Ogden Surveying Equipment Co., 5520 Elvas Ave.
San Diego: *†Arey Jones Co., 933 Fourth St.; *†Nuttall-Styris Co., 825 Columbia St.
San Francisco: C&GS, 121 Customhouse; *†C. J. Hendry Co., 139 Townsend St.; *†George E. Butler, 356 California St.; *† San Francisco Instrument Co., 840 Battery St., Room 15.
San Pedro: *†C. J. Hendry Co., 111 S. Front St.; *†Globe Nautical Instrument Co., Inc., 261 West 7th St.; *†Marine Hardware Co., 34 South Beacon St.; *†Southwest Instrument Co., 235 West 7th St.
San Rafael: †Western Boat Shop, 101 Third St.
Santa Barbara: Seacoast Marine Corp., Breakwater.
Santa Monica: Yachtsmens Mart, 8921 Main St.
Sausalito: †Bauman Bros. & Dick Miller, Sausalito Yacht Harbor.
Stockton: Morris Bros., 15–17 North Hunter St.
Tahoe City: Tahoe Boat Co.
Tiburon: Tiburon Hardware & Marine, 1650 Tiburon Blvd.
Vallejo: Vallejo Boat Center, 823 Wilson Ave.
Venice: Jeffries Marine Supply Store, 4241 Lincoln Blvd.
Ventura: County Stationers, Inc., 532 East Main; *Seacoast Marine Corp., 6541 Ventura Blvd.

Oregon:

Astoria: Englund Marine Supply Co., Foot of 15th St.
Coos Bay: Independent Stevedore Co., Inc.
Newport: †Andy Smith Marine Supplies, 252 Bay Blvd.
North Bend: Oregon-Pacific Co., Inc.
North Portland: Columbia Marine Electronics, Kai's Boat Harbor.
Portland: †C&GS, Room 314 U.S. Court House Bldg., 620 S.W. Main St.; Eighty Second St. Marine, 2815 S.E. 82d St.; *†Frank H. Parks, 414 S.W. 3d Ave.; Portland Precision Instrument & Repair Co., 331 S.W. 4th Ave.

Washington:

Anacortes: †Marine Supply & Hardware; †Transmission Supply, 902 Commercial St.
Bellingham: Griggs Stationery & Printing Co., 120 East Holly St.
Bremerton: Bremerton Marine Supply, Inc., 1234 Charleston Beach.
Coulee Dam: Coulee Dam Nature & History Association.
Everett: Black & King, 2944 Colby Ave.; Robinson Marina, 19th & Norton St.
Friday Harbor: †Friday Harbor Drug Co.
Hoquiam: Industrial & Marine Supply Co., 701 Levee St.
Kelso: Cowlitz Marina, 85 Catlin St.
Neah Bay: Washburn's General Merchandise.
Oak Harbor: Chuck Dann's Sporting Goods, Inc., 1150 W. Pioneer Way.
Olympia: Capitol Towing & Marina, Columbia & B St.
Port Angeles: †Willson Hardware Co., 111 West First St.
Seattle: C&GS, 705 Federal Office Bldg.; Chartmaster Co., 8306 16th St., N.W.; *†Max Kuner Co., 1324 Second Ave.; *†Metsker Maps, 1020 Third Ave.; *†Northwest Instrument Co., 1403 West 45th St.; †Shrock the Compass Adjuster, 1117 East Northlake Ave.; *†Shrock the Compass Adjuster, Fisherman's Dock.
Tacoma: *†Metsker Maps, 111 South Tenth St.
Wallula: Kelly's Marine Supply, The Wallula Junction.

British Columbia:

Vancouver: *†Bovey Marine 1952, 1117 W. Pender St.; *Frederick Goertz, Ltd., 1328 West Pender St.; *Kelvin Hughes Div. S. Smith & Sons (Canada) Ltd., 1790 W. Georgia St.; *Western Marine Supply Co., Ltd. 528 Powell St.
Victoria: *Ship Chandlers (McQuades) Ltd., 1252 Wharf St.

Hawaii:

Honolulu: Coast and Geodetic Survey Office, Federal Office Bldg.; †McWayne Marine Supply Ltd., 1115 Ala Moana Blvd.
Kailua-Kona: KonaMar, Inc.

PUBLICATIONS.—A résumé of the U.S. Government publications of navigational value is included for the ready reference of the mariner. In addition to the agents located in the principal seaports handling sales publications, certain libraries have been designated by the Congress of the United States to receive the publications as issued for public review.

Nautical Charts.—Coasts of the United States and Possessions: published by U.S. Coast and Geodetic Survey; for sale by C&GS and its sales agents.

Mississippi River (Cairo, Ill., to Gulf of Mexico): Published aud for sale by Mississippi River Commission, Vicksburg, Miss.

Mississippi River (Cairo, Ill., to Minneapolis, Minn.) and Illinois Waterway (Mississippi River to Lake Michigan): published and for sale by U.S. Army Engineer District, Chicago, Ill.

Great Lakes, Lake Champlain, New York State Canals, and the St. Lawrence River-St. Regis to Cornwall, Canada: Published and for sale by U.S. Lake Survey, Detroit, Mich.

Foreign countries: Published by U.S. Naval Oceanographic Office; for sale by that office and its sales agents.

Coast Pilots.—Coasts of the United States and Possessions: Published by U.S. Coast and Geodetic Survey; for sale by C&GS and its sales agents.

Great Lakes Pilot published and for sale by U.S. Lake Survey, Detroit, Mich.

Foreign countries (Sailing Directions): Published by U.S. Naval Oceanographic Office; for sale by that office and its sales agents.

Tide and Tidal Current Tables, and Tidal Current Charts.—Published by U.S. Coast and Geodetic Survey; for sale by C&GS and its sales agents.

Notices to Mariners may be obtained free from the following: Local Notices to Mariners—District Commander of the local Coast Guard district; Weekly Notice to Mariners, Part I (Atlantic Coast and Mediterranean) and Part II (Pacific and Indian Oceans)—U.S. Naval Oceanographic Office; Weekly Notice to Mariners, Great Lakes—Commander, Ninth Coast Guard District, Cleveland, Ohio.

Light Lists.—United States and Possessions: Published by U.S. Coast Guard; for sale by the Superintendent of Documents and his sales agents.

Foreign countries: Published by U.S. Naval Oceanographic Office; for sale by that office and its sales agents.

Radio.—Radio Navigational Aids, Atlantic and Mediterranean Area (H.O. Pub. No. 117A); Radio Navigational Aids, Pacific and Indian Oceans Area (H.O. Pub. No. 117B); Radio Weather Aids (H.O. Pub. No. 118); Weather Station Index (H.O. Pub. No. 119); and International Code of Signals, Vol. II—Radio (H.O. Pub. No. 104): Published by U.S. Naval Oceanographic Office; for sale by that office and its sales agents.

Miscellaneous.—The Nautical Almanac, and American Ephemeris and Nautical Almanac: Published by United States Naval Observatory; for sale by Superintendent of Documents and his sales agents.

American Practical Navigator (Bowditch) (H.O. Publication No. 9), and International Code of Signals, Volume I—Visual (H.O. Publication No. 103): Published by U.S. Naval Oceanographic Office; for sale by that office and its sales agents.

Rules of the Road, International—Inland (CG–169). Rules of the Road, Western Rivers (CG–184). Rules of the Road, Great Lakes (CG–172): Published by and free on application to the U.S. Coast Guard.

Port Series of the United States: Part I (port administration and services) published by Maritime Administration, U.S. Department of Commerce: Part II (port conditions and facilities) published by Corps of Engineers, U.S. Army. Both parts are for sale by the Superintendent of Documents.

CORPS OF ENGINEERS, U.S. ARMY.—District offices and areas covered by this Coast Pilot follow:

Los Angeles District, 751 South Figueroa Street, Los Angeles 17, Calif. Coastal waters and tributaries of California from the Mexican boundary to Cape San Martin (35°54′ N., 121°27′ W.).

San Francisco District, 180 New Montgomery Street, San Francisco 19, Calif. Coastal waters and tributaries of California from Cape San Martin to the Oregon boundary, including San Francisco Bay but not Suisun Bay and the Sacramento and San Joaquin Rivers and their tributaries.

Sacramento District, 650 Capitol Avenue, Federal and Courts Building, Sacramento, Calif. Suisun Bay, and the Sacramento and San Joaquin Rivers and their tributaries.

Portland District, 628 Pittock Block, Southwest 10th Avenue and Washington Street, Portland 5, Oreg. Coastal waters and tributaries of Oregon, and the waters and tributaries of Columbia River as far as the John Day damsite.

Walla Walla District, Building 602, City-County Airport, Walla Walla, Wash. Columbia River and tributaries above the John Day damsite.

Seattle District, 1519 South Alaskan Way, Seattle 4, Wash. Coastal waters and tributaries of Washington except Columbia River.

Honolulu District, Building 96, Fort Armstrong, Honolulu, Hawaii. The State of Hawaii; Line, Gilbert, Marshall, Midway, Wake, and Johnston Islands; and such islands in the South Pacific Ocean lying between the 159th meridian of east longitude and 108th meridian of west longitude as may be under the jurisdiction of the United States.

COAST GUARD.—District offices and areas covered by this Coast Pilot follow:

Commander, 11th Coast Guard District, 706 Times Building, Long Beach 2, Calif. Coastal waters and tributaries in California south of 34°58′ N.

San Diego Captain of the Port, Coast Guard Air Station, 2710 Harbor Drive, San Diego 12, Calif.

Los Angeles Captain of the Port, P.O. Box 1251, Long Beach, Calif.

Commander, 12th Coast Guard District, 630 Sansome Street, San Francisco 26, Calif. Coastal waters and tributaries in California north of 34°58′ N.

San Francisco Captain of the Port, Pier 45½, San Francisco 11, Calif.

Commander, 13th Coast Guard District, 618 Second Avenue, Seattle 4, Wash. Coastal waters and tributaries in Oregon, Washington, and Idaho.

Portland Captain of the Port, 208 S.W. 5th Avenue, Portland 12, Oreg.

Seattle Captain of the Port, Pier 39, 1519 S. Alaskan Way, Seattle 1, Wash.

Commander, 14th Coast Guard District, 1347 Kapiolani Boulevard, Honolulu, Hawaii. Hawaii and the Pacific Islands belonging to the United States west of 140° W. and south of 42° N.

Honolulu Captain of the Port, Pier 11, Honolulu, Hawaii.

Lifeboat Stations.—The lifeboat stations operated by the Coast Guard on the Pacific coast are:

Monterey, Calif. (No. 308), 36°36.5′ N., 121°53.7′ W. At the foot of Monterey Breakwater.

Fort Point, Calif. (No. 310), 37°48.3′ N., 122°28.0′ W. On Presidio, near south tower of Golden Gate Bridge.

Point Reyes, Calif. (No. 313), 37°59.6′ N., 122°58.3′ W. Drakes Bay, 2.3 miles east of Point Reyes Light.

Humboldt Bay, Calif. (No. 316), 40°46.0′ N., 124°13.0′ W. East side of North Spit at entrance to Humboldt Bay.

Port Orford, Oreg. (No. 318), 42°44.3′ N., 124°30.5′ W. At head of Nellies Cove.

Coos Bay, Oreg. (No. 320), 43°20.9′ N., 124°19.8′ W. South side of entrance to Coos Bay, about 0.3 mile east of Coos Head.

Umpqua River, Oreg. (No. 321), 43°39.9′ N., 124°11.9′ W. About 350 yards north of Umpqua River Light.

Yaquina Bay, Oreg. (No. 323), 44°37.6′ N., 124°03.3′ W. Newport waterfront, north side of bay, near bridge.

Tillamook Bay, Oreg. (No. 325), 45°33.5′ N., 123°55.2′ W. North shore at Garibaldi.

Point Adams, Oreg. (No. 326), 46°12.0′ N., 123°56.8′ W. At Hammond.

Cape Disappointment, Wash. (No. 327), 46°16.8′ N., 124°02.7′ W. At Fort Canby on southwest side of Baker Bay.

Willapa Bay, Wash. (No. 329), 46°42.4′ N., 124°58.0′ W. At end of Toke Point.

Grays Harbor, Wash. (No. 330), 46°54.5′ N., 124°06.6′ W. On west side of Westhaven Harbor.

Quillayute River, Wash. (No. 331), 47°54.5′ N., 124°38.2′ W. At La Push.

Neah Bay, Wash. (No. 332), 48°22.3′ N., 124°35.8′ W. About 0.5 mile southward of Waada Island.

CUSTOMS DISTRICTS.—The first-named ports in the following list are the headquarters ports. An asterisk (*) precedes the names of ports authorized to issue marine documents.

San Diego District: The limits are the counties of San Diego and Imperial in the State of California.

Port of entry: *San Diego.

Los Angeles District: The limits are that part of the State of California lying south of the northern boundaries of the counties of San Luis Obispo, Kern, and San Bernardino, except the counties of San Diego and Imperial.

Ports of entry: *Los Angeles, Port San Luis.

San Francisco District: The limits are that part of the State of California lying north of the northern boundaries of the counties of San Luis Obispo, Kern, and San Bernardino.

Ports of entry: *San Francisco-Oakland (including all points on San Francisco Bay); *Eureka.

Oregon District: The limits are the State of Oregon and that part of the State of Washington which embraces the waters of Columbia River and the north bank of said river west of 119° W.

Ports of entry: *Portland, *Astoria, *Coos Bay, Longview, Newport.

Washington District: The limits are the State of Washington except that part which embraces the waters of the Columbia River and the north bank of the said river west of 119° W.

Ports of entry: *Seattle, *Aberdeen, Anacortes, *Bellingham, Blaine, Everett, Friday Harbor, Neah Bay, Northport, Olympia, *Port Angeles, *Port Townsend, *Tacoma, South Bend-Raymond.

Hawaii District: The limits include all of Hawaii.

Ports of entry: *Honolulu, Hilo, Kahului, Port Allen.

PUBLIC HEALTH SERVICE.—Quarantine Stations where supervision of quarantine and medical examination of aliens are performed:

San Diego: Medical Officer in charge, Quarantine Station, Shelter Island, San Diego 6, Calif.

San Pedro: Medical Officer in charge, Terminal Island, P.O. Box 97, San Pedro, Calif.

San Francisco: Medical Officer in charge, 3015 Ferry Bldg., San Francisco 11, Calif.

Seattle: Medical Officer in charge, 33 Federal Building, Seattle 4, Wash.

Honolulu: Medical Officer in charge, P.O. Box 1410, Honolulu, Hawaii.

Portland: 221 U.S. Courthouse Building, Portland 5, Oreg., is an additional office from which quarantine services are performed.

Hospitals:

San Francisco: 15th Avenue and Lake Street, San Francisco 18, Calif.

Seattle: 1131 14th Avenue, South, Seattle 14, Wash.

Outpatient Clinics:

San Diego: 208 New Post Office Building, San Diego 1, Calif.

San Pedro: 314 Federal Building, 825 South Beacon Street, San Pedro, Calif.

Los Angeles: 424 Federal Building, 312 North Spring Street, Los Angeles 12, Calif.

Portland: 220 U.S. Courthouse, Broadway and Main Streets, Portland 5, Oreg.

Honolulu: 208 Federal Building, Honolulu 7, Hawaii.

Outpatient Offices:

Eureka, Calif.: Medical-Dental Building, 730 Seventh Street.

Astoria, Oreg.: 486 12th Street.

Coos Bay, Oreg.: 510 Hall Building, 320 West Central Avenue.

Newport, Oreg.: 625 South Hubert Street.

Aberdeen, Wash.: 700 Becker Building, 110 South First Street.

Anacortes, Wash.: 1302 8th St.

Bellingham, Wash.: G-19 Bellingham Medical Center, 18 C St.

Everett, Wash.: 3202 Colby Avenue.

Olympia, Wash.: 529 West Fourth Street.

Port Angeles, Wash.: 926 Caroline St.

Port Townsend, Wash.: 1136 Water Street.

IMMIGRATION and NATURALIZATION.—Offices of these services are in the following places:

California:

San Diego: Lindbergh Field.
Los Angeles: 510 S. Vermont Ave.
San Pedro: Terminal Island.
San Luis Obispo: 793 Higuerra St.
San Francisco: Appraisers Bldg., 630 Sansome St.
Sacramento: Federal and U.S. Courthouse Bldg., 650 Capitol Ave.

Oregon:

Portland: 333 U.S. Courthouse Bldg., Broadway and Main Sts.

Washington:

Aberdeen: U.S. Post Office Bldg., 2d and G Sts.
Anacortes: 202 Burton Bldg., 2d and Commercial Sts.
Bellingham: U.S. Post Office Bldg., Magnolia and Cornwall Sts.
Port Angeles: U.S. Post Office Bldg., First and Oak Sts.
Seattle: 815 Airport Way.
Tacoma: U.S. Post Office Bldg., 11th and A Sts.

Hawaii:

Honolulu: Ala Moana Blvd.

FEDERAL COMMUNICATIONS COMMISSION.—District field offices:

Los Angeles: 849 S. Broadway, Los Angeles 12, Calif.
San Francisco: Room 323A, U.S. Customhouse, 555 Battery Street, San Francisco 26, Calif.
Portland: Room 507, New U.S. Courthouse Building, 620 Southwest Main Street, Portland 5, Oreg.
Seattle: Room 802, Federal Office Building, Seattle 4, Wash.
Honolulu: Room 502, Federal Building, Honolulu 1, Hawaii.

WEATHER BUREAU.—Offices: In the area covered by this Coast Pilot, the Weather Bureau operates a marine center from which personnel will visit ships to compare barometers and other weather instruments, and at other Weather Bureau offices barometers may be brought in for comparison with standards, as follows:

Marine center:

San Francisco, Calif., Room 216, U.S. Customhouse, 555 Battery St.

Comparison offices:

San Diego, Calif.: Lindbergh Field.
Long Beach, Calif.: Pier A, Berth 9.
Los Angeles, Calif.: International Airport.
Oakland, Calif.: Oakland Municipal Airport.
Eureka, Calif.: Weather Bureau Office.
Astoria, Oreg.: Clatsop County Airport.
Portland, Oreg.: Airport Station.
Seattle, Wash.: Room 703, Federal Office Bldg.
Honolulu, Hawaii: Weather Bureau Office, Pier 2.

Radiotelephone broadcasts by Coast Guard.—Scheduled marine information broadcasts of notices to mariners, hydrographic information, storm warnings, small-craft warnings, advisories, and other important marine information are broadcast by radiotelephone at the scheduled times and indicated frequencies preceded by an initial call on 2182 kc. Urgent and safety broadcasts are made on 2182 kc. upon receipt.

NMQ, Long Beach, Calif., 2670 kc., 0500 and 1700 GMT.
NMC, San Francisco, Calif., 2670 kc., 0430 and 1630 GMT.
NMW, Westport, Wash., 2670 kc., 0530 and 1730 GMT.
NOW, Port Angeles, Wash., 2670 kc., 0545 and 1745 GMT.
NMW43, Seattle, Wash., 2670 kc., 1715 GMT.
NMO, Honolulu, Hawaii, 2670 kc., 0600 and 1800 GMT.

Radiotelegraph broadcasts by Coast Guard.—Scheduled marine information broadcasts of notices to mariners, hydrographic information, forecasts, reports, storm warnings, advisories, and other important marine information are broadcast by radiotelegraph at the scheduled times and indicated frequencies, preceded by an initial call on 500 kc. Urgent broadcasts are made on 500 kc. upon receipt and repeated during the last 15 seconds of the first silent period after receipt. Whenever this transmission occurs outside the watch hours for single radio-operator ships, the message will be repeated at the end of the next silent period falling within the radio watch hours for such vessels. Urgent broadcasts are preceded by the Urgent Signal (XXX).

NMQ, Long Beach, Calif., 472 kc., 0420 and 1720 GMT.
NMC, San Francisco, Calif., 486 kc., 0400 and 1700 GMT.
NMW, Westport, Wash., 440 kc., 0430 and 1700 GMT.
NMO, Honolulu, Hawaii, 440 kc., 0530 and 2000 GMT.

Weather broadcasts by commercial radio stations.—Taped or direct broadcasts of forecasts and storm warnings are made by commercial radio stations in the areas covered by this Coast Pilot. These usually are made several times daily; broadcast times are published in local newspaper radio program schedules, and in the Coastal Warning Facilities Charts issued annually by the U.S. Weather Bureau. The charts are on sale, 10 cents each, by Superintendent of Documents, Washington, D.C., 20402.

STORM WARNING STATIONS.—Weather Bureau listing of display stations in the area covered by this Coast Pilot follow. **DN** indicates day and night display; **D**, day display only; **W**, no display, posted warnings only; **(S)** seasonal display only.

★ (5696) **WASHINGTON—Strait of Juan de Fuca—Storm warning display station—Information.**—The U.S. Weather Bureau advises that the storm warning display station at Tatoosh Island (48°23.5′ N., 124°44.0′ W. approx.) has been discontinued.

(L.N.M. 52, C.G., Seattle, Aug. 11, 1966.) (N.M. 36/66.)
C. & G.S. Charts **6265, 6102, 6300.**
C. & G.S. Coast Pilot 7, 1963, page **278.**

★ (5385) **WASHINGTON—Puget Sound—Shilshole Bay—Coastal warning display station established.**—The U.S. Weather Bureau advises that a daytime storm warning display station has been established in (approx.) 47°40.8′ N., 122°24.3′ W.

(L.N.M. 45, C.G., Seattle, July 14, 1966.) (N.M. 34/66.)
C. & G. S. Charts **6445, 6450, 6401, 690SC, 185SC.**
C. & G.S. Coast Pilot 7, 1963, pages 211, **278.**

★ (4114) **CALIFORNIA—Mission Bay—Coastal warning display station—Position amended.**—The U.S. Weather Bureau advises that the correct geographical position of the coastal warning display station at Mission Beach, San Diego, Calif., is 32°45.7′ N., 117°14.4′ W.

(L.N.M. 55, C.G., Long Beach, July 20, 1964.) (N.M. 32/64.)
C. & G.S. Charts **5107, 5101.**
C. & G.S. Coast Pilot 7, 1963, pages 95, **278.**

★ (4554) **CALIFORNIA—Ventura Marina—Coastal Storm Warning Display Station established.**—The U.S. Weather Bureau advises that a Coastal Storm Warning Display Station, for day and night displays, has been established at Ventura Marina in 34°15.1′ N., 119°15.9′ W. (N.M. 35/64.)

(L.N.M. 60, C.G., Long Beach, Aug. 7, 1964.)
C. & G.S. Charts **5007** (and inset), **5202.**
C. & G.S. Coast Pilot 7, 1963, pages 102, **278.**

★ (3161) **WASHINGTON—Bellingham Bay—Coastal warning display station relocated.**—The U.S. Weather Bureau advises that the coastal warning display station (48°44.5′ N., 122°29.2′ W.) in Bellingham, Wash., has been relocated in 48°45.4′ N., 122°30.2′ W.

(N.M. 22/65.)

(L.N.M. 21, C.G., Seattle, Apr. 29, 1965.)
C. & G.S. Charts **6378, 184SC, 6380, 6300.**
C. & G.S. Coast Pilot 7, 1963, pages 204, **278.**

★ (4249) **OREGON—Tillamook Bay—Storm warning display station established.**—A storm warning display station has been established at Garibaldi Boat Basin in 45°33′16″ N., 123°54′49″ W.
(See N.M. 30(3850) 1964.)

(N.M. 33/64.)

(L.N.M. 38, C.G., Seattle, July 23, 1964.)
C. & G.S. Chart **6112.**
C. & G.S. Coast Pilot 7, 1963, pages 161, **278.**

★ (4740) **HAWAII—Kauai—Waimea Bay—Coastal warning display station established.**—The U.S. Weather Bureau advises that a coastal warning display station for day displays only has been established at Kikiaola Boat Harbor in 21°57.6′ N., 159°41.6′ W.

(N.M. 33/65.)

(L.N.M. 29, C.G., Honolulu, July 21, 1965.)
C. & G.S. Charts **4114, 4100.**
C. & G.S. Coast Pilot 7, 1963, pages 262, **278.**

★ (3052) **OREGON—Coquille River—Coastal Warning Display Station established.**—The U.S. Weather Bureau advises that a Coastal Warning Display Station, for day displays only, has been established at the Coquille River Coast Guard Station.

Approx. position: 43°07'14'' N., 124°25'02'' W. (N.M. 24/64.)

(L.N.M. 26, C.G., Seattle, May 22, 1964.)
C. & G.S. Charts **5971, 5802.**
C. & G.S. Coast Pilot 7, 1963, pages **154, 278.**

★ (3850) **OREGON—Tillamook Bay—Storm warning display station moved.**—The storm warning display station at Tillamook Bay Coast Guard Station (45°33.5' N., 123°55.2' W.) has been relocated at the Coast Guard Lookout Tower in 45°34'07'' N., 123°56'35'' W.

(N.M. 30/64.)

(L.N.M. 34, C.G., Seattle, July 1, 1964.)
C. & G.S. Chart **6112.**
C. & G.S. Coast Pilot 7, 1963, pages 161, **278.**

★ (6254) **OREGON—Cape Arago—Coos Bay—Storm warning displays—Information.**—1. Cape Arago day and night storm warning display station (43°20.5' N., 124°22.5' W. approx.) has been discontinued.

2. Coos Head Lookout storm warning station has been relocated in (approx.) 43°21.1' N., 124°20.1' W. and now exhibits day and night displays.

(N.M. 40/66.)

(L.N.M. 58, C.G., Seattle, Sept. 8, 1966.)
C. & G.S. Charts **5984, 5802.**
C.G. Light List, Vol. III, 1966, No. **81.**
C. & G.S. Coast Pilot 7, 1963, pages **278, 155.**

★ (2239) **HAWAII—Oahu—Honolulu Harbor—Coastal Warning Station established.**—The U.S. Weather Bureau advises that a day and night Coastal Warning Display Station has been established in Keehi Marina in 21°19.2′ N., 157°53.6′ W.

(N.M. 16/65.)

(L.N.M. 11, C.G., Honolulu, Mar. 23, 1965.)
C. & G.S. Charts **4109, 4132.**
C. & G.S. Coast Pilot 7, 1963, pages 254, **278.**

★ (5348) **CALIFORNIA—Los Angeles-Long Beach Harbors—Coastal Warning Display Station discontinued.**—The U.S. Weather Bureau advises that the Coastal Warning Display Station in 33°43.2′ N., 118°16.2′ W. at San Pedro, Calif. has been discontinued.

(N.M. 41/64.)

(L.N.M. 71, C.G., Long Beach, Sept. 14, 1964)
C. & G.S. Charts **5147, 5148.**
C. & G.S. Coast Pilot 7, 1963, pages 599, **278.**

California:

DN Cabrillo National Monument; 32°40.3′, 117°14.4′.
D Coronado Yacht Club; 32°40.8′, 117°10.5′.
DN San Diego, Shelter Island; 32°42.5′, 117°14.0′.
DN San Diego, Municipal Pier No. 2; 32°43.0′, 117°10.5′.
DN Mission Beach; 32°45.6′, 117°14.8′.
DN Avalon, pleasure pier; 33°20.6′, 118°19.5′.
DN Newport Beach Harbor; 33°36.2′, 117°53.0′.
DN Los Angeles Light; 33°42.5′, 118°15.0′.
DN San Pedro; 33°43.2′, 118°16.2′.
~~D Los Angeles, Terminal Island; 33°43.9′, 118°15.8′.~~
DN Long Beach; 33°44.9′, 118°12.9′.
DN Long Beach Marina; 33°45.0′, 118°06.8′.
D Los Angeles, Wilmington; 33°46.0′, 118°15.0′.
D Redondo Beach; 33°50.8′, 118°23.7′.
DN Marina del Rey; 33°58.2′, 118°26.8′.
DN Santa Monica Pier; 34°00.5′, 118°30.0′.
DN Port Hueneme; 34°09.0′, 119°12.0′.
DN Santa Barbara; 34°24.2′, 119°41.5′.
D Port San Luis; 35°10.7′, 120°44.0′.
D Morro Bay; 35°21.9′, 120°51.1′.
DN Monterey Lifeboat Station; 36°36.5′, 121°53.7′.
~~D Palo Alto Yacht Harbor; 37°27.4′, 122°06.5′.~~
D San Francisco Lightship; 37°45.0′, 122°41.5′.
~~D Oakland Harbor Light Station; 37°48.0′, 122°19.8′.~~
DN San Francisco, Telephone Bldg.; 37°47.2′, 122°24.0′.
D San Francisco, Pier 45D; 37°48.7′, 122°25.2′.
D Sausalito; 37°51.2′, 122°28.7′.
D Berkeley Yacht Harbor; 37°52.0′, 122°19.0′.
D San Joaquin River, Antioch Bridge; 38°01.2′, 121°45.2′.
D Brokerage Wharf, Bethel Island; 38°00.8′, 121°38.4′.
~~W Fort Bragg; 39°26.5′, 123°48.0′.~~
D Blunts Reef Lightship; 40°26.4′, 124°30.2′.
DN Humboldt Bay Lifeboat Station; 40°46.0′, 124°13.0′.
D Eureka; 40°48.3′, 124°10.3′.

Oregon:

D Chetco River, Port of Brookings; 42°02.7′, 124°16.1′.
~~DN Cape Arago Light Station; 43°20.5′, 124°22.5′.~~
DN Charleston, small-boat basin; 43°20.8′, 124°19.4′.
D Coos Head Lookout; 43°21.1′, 124°20.1′.
DN Umpqua River Lifeboat Station; 43°40.0′, 124°12.0′
D Florence; 43°58.0′, 124°06.3′.
DN Yaquina Bay Lifeboat Station; 44°37.6′, 124°03.3′.
DN Yaquina Head Light Station; 44°40.6′, 124°04.7′.
D Winchester Bay; 43°40.7′, 124°10.4′.
D Depoe Bay, CG mooriugs; 44°48.6′, 124°03.5′.
D Tillamook Bay Lifeboat Station; 45°33.5′, 123°55.2′.
D Columbia River Lightship; 46°11.0′, 124°11.0′.
DN Point Adams Lifeboat Station; 46°12.0′, 123°56.7′.

Washington:

D Ilwaco; 46°18.4′, 124°02.2′ (S).
~~DN Tatoosh Island; 48°23.5′, 124°44.0′.~~
D Redondo; 47°20.9′, 122°19.4′.
DN South Bend; 46°40.4′, 123°46.7′.
DN Willapa Bay Lifeboat Station; 46°42.3′, 123°58.0′.
DN Grays Harbor Lifeboat Station; 46°54.6′, 124°07.0′.
D Tacoma, Narrows Marina; 47°14.7′, 122°33.4′.
D Tacoma, Pier 2; 47°16.6′, 122°24.7′.
D Tacoma, Point Defiance; 47°18.4′, 122°31.0′.
DN Seattle Yacht Club; 47°38.7′, 122°18.4′.
D Seattle, Leschi Park; 47°36.1′, 122°17.0′.
D Seattle, U.S. Locks; 47°40.0′, 122°23.7′.
D Quillayute River Lifeboat Station; 47°54.4′, 124°38.0′.
D Umatilla Reef Lightship; 48°10.0′, 124°50.4′.
DN Neah Bay Lifeboat Station; 48°22.3′, 124°35.8′.
DN Port Angeles; 48°07.2′, 123°26.5′.
DN New Dungeness Light Station; 48°10.9′, 123°06.5′.
DN Everett City Dock; 47°58.8′, 122°13.2′.
DN Port Townsend; 48°07.1′, 122°45.3′.
DN Bellingham; 48°44.5′, 122°29.2′.
DN Blaine; 48°59.8′, 122°45.1′.

Hawaii:

D Upolu Point, Hawaii; 20°15.3′, 155°53.4′.
~~D Hilo, C.G. Moorings, Hawaii; 19°43.7′, 155°04.4′.~~
~~D Kailua, Hawaii; 19°38.6′, 156°00.0′.~~
D Mahukona, Hawaii; 20°11.3′, 155°54.3′.
D Hana, Maui; 20°45.6′, 155°59.1′.
D Maalaea, Maui; 20°47.7′, 156°30.8′.
D Lahaina, Maui; 20°52.5′, 156°40.9′.
D Kahului Harbor, Maui; 20°53.9′, 156°28.3′.
D Kaumalapau Harbor, Lanai; 20°47.3′, 156°59.5′.
D Kaunakakai, Molokai; 21°05.0′, 157°01.9′.
D Makapuu Point, Oahu; 21°18.8′, 157°39.2′.
D Honolulu, Ala Wai Yacht Harbor, Oahu; 21°17.4′, 157°50.6′.
D Honolulu, Kewalo Basin, Oahu; 21°17.7′, 157°51.4′.
D Honolulu, Aloha Tower, Oahu; 21°18.6′, 157°52.1′.
D Kaneohe, Mokapu Peninsula, Oahu; 21°26.5′, 157°46.0′.
D Kaneohe Yacht Club, Oahu; 21°25.1′, 157°46.3′.
D Nawiliwili Jetty, Kauai; 21°57.4′, 159°21.3′.

LEGAL HOLIDAYS.—In the areas covered by this Coast Pilot, the following holidays are observed throughout:

January 1, New Year's Day; February 22, Washington's Birthday; May 30, Memorial Day; July 4, Independence Day; first Monday in September, Labor Day; November 11, Veterans Day; fourth Thursday in November, Thanksgiving Day; December 25, Christmas Day.

In addition, Hawaii observes: March 26, Kuhio Day; Good Friday; and June 11, Kamehameha Day. California observes its Admission Day, September 9. California, Oregon, and Washington observe Lincoln's Birthday, February 12.

CLIMATOLOGICAL TABLES

These tables were compiled from U. S. Weather Bureau data.

Sky cover is expressed in a range of 0 for no clouds to 10 for complete sky cover. The number of clear days is based on average cloudiness of 0 to 3, partly cloudy days on 4 to 7, and cloudy days on 8 to 10.

Heavy fog includes data referred to at various times in the past as "Dense" or "Thick." The upper visibility limit for heavy fog is 1/4 mile.

(a) means length of record in years.
* means less than one-half.
T means trace, an amount too small to measure.

SAN DIEGO, CALIF. (Lindbergh Field) 32°44'N., 117°10'W. Elevation (ground) 13 feet. WB-1961

Month	Air temperature (°F.) Normal: Daily maximum	Daily minimum	Monthly	Extreme: Record highest	Record lowest	Precipitation (inches): Normal total	Maximum in 24 hrs.	Snow, sleet, mean total	Humidity (percent): 10:00 a.m. PST	4:00 p.m. PST	Wind (knots): Mean speed	Prevailing direction	Maximum speed and direction	Percent of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, sleet 1.0 inch or more	Thunderstorms	Heavy fog
(a)				20	20		21	21	21	21	21	13	18	21	21	21	21	21	21	21	21	21
Jan.	64.3	45.5	54.9	88	29	1.69	2.65	T	57	59	4.8	NE	34 SW	68	5.0	13	7	11	7	0	*	4
Feb.	65.0	47.5	56.3	88	36	2.26	1.71	0.0	56	58	5.3	NE	30 SW	71	4.9	11	8	9	6	0	*	3
Mar.	66.5	49.8	58.2	88	41	1.52	2.40	0.0	57	58	5.9	WNW	40 SW	70	5.0	12	10	9	7	0	*	2
Apr.	67.8	53.1	60.5	92	41	0.83	1.22	0.0	61	60	6.3	WNW	32 S	61	5.5	9	10	11	5	0	*	2
May	69.6	56.7	63.2	96	48	0.26	0.42	0.0	62	62	6.5	WSW	23 SW	59	5.4	10	11	10	2	0	*	1
June	71.5	59.6	65.6	97	50	0.04	0.26	0.0	67	64	6.3	SSW	23 S	58	5.2	10	13	7	1	0	*	1
July	75.5	63.1	69.3	93	55	0.01	0.08	0.0	68	64	5.8	WNW	16 SW	67	4.4	13	14	4	*	0	*	1
Aug.	76.5	64.0	70.3	98	57	0.05	0.83	0.0	67	65	5.7	WNW	20 SW	68	4.2	15	12	4	*	0	*	1
Sep.	75.9	61.5	68.7	104	51	0.17	0.62	0.0	65	64	5.4	NW	22 W	69	3.7	17	9	4	1	0	*	4
Oct.	73.0	56.9	65.0	98	45	0.63	1.20	0.0	61	64	5.1	WNW	27 N	66	4.2	14	10	7	2	0	*	4
Nov.	70.9	50.6	60.8	96	40	0.83	2.44	0.0	52	59	4.6	NE	44 SE	75	3.7	16	8	6	4	0	*	5
Dec.	66.4	47.4	56.9	85	35	2.57	3.07	0.0	55	60	4.5	NE	30 S	70	4.6	14	8	9	6	0	*	5
Year	70.2	54.6	62.4	104	29	10.86	3.07	T	61	61	5.6	WNW	44 SE	67	4.7	154	120	91	42	0	3	33

LOS ANGELES, CALIF. (International Airport) 33°56'N., 118°23'W. Elevation (ground) 97 feet. WB-1961

Month	Air temperature (°F.) Normal: Daily maximum	Daily minimum	Monthly	Extreme: Record highest	Record lowest	Precipitation (inches): Normal total	Maximum in 24 hrs.	Snow, sleet, mean total	Humidity (percent): 10:00 a.m. PST	4:00 p.m. PST	Wind (knots): Mean speed	Prevailing direction	Maximum speed and direction	Percent of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days: Sunrise to sunset: Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, sleet 1.0 inch or more	Thunderstorms	Heavy fog
(a)				2	2		26	26	2	2	13	26	12		13	26	26	26	26	26	19	29
Jan.	63.3	43.0	53.2	83	36	2.01	6.19	T	48	53	5.4	W	42 SW		5.3	12	8	11	7	0	*	6
Feb.	63.3	44.8	54.1	79	40	2.75	3.79	T	55	61	5.8	W	50 N		4.8	12	6	10	6	0	*	4
Mar.	65.2	47.8	56.5	82	42	1.91	2.36	0.0	65	67	6.3	W	54 W		5.1	12	8	11	5	0	*	5
Apr.	66.8	51.5	59.2	88	46	0.96	1.88	0.0	58	61	6.6	WSW	51 N		5.4	10	9	11	4	0	*	3
May	68.9	55.3	62.1	79	49	0.30	0.56	0.0	61	62	6.5	WSW	39 N		5.0	11	9	11	1	0	0	2
June	71.5	57.8	64.7	82	53	0.07	0.07	0.0	73	70	6.2	WSW	28 W		4.7	9	11	10	*	0	0	2
July	74.4	60.8	67.6	92	58	T	0.05	0.0	69	71	5.9	WSW	25 W		4.0	11	13	7	1	0	*	2
Aug.	75.0	61.3	68.2	83	59	0.02	0.21	0.0	73	74	5.8	WSW	29 SE		4.1	11	13	7	*	0	*	3
Sep.	74.6	58.7	66.7	101	57	0.21	4.20	0.0	66	68	5.4	WSW	23 SW		3.9	13	11	6	1	0	*	5
Oct.	72.3	54.5	63.4	106	46	0.43	1.21	0.0	58	66	5.2	W	40 N		4.3	13	10	8	2	0	*	6
Nov.	70.2	48.4	59.3	89	43	1.10	2.91	0.0	59	67	5.0	W	48 N		4.2	15	8	7	3	0	*	7
Dec.	65.9	45.3	55.6	88	38	2.61	3.01	0.0	57	67	5.0	W	43 S		4.6	12	9	10	6	0	*	7
Year	69.3	52.4	60.9	106	36	12.37	6.19	T	62	66	5.7	W	54 W		4.6	141	115	109	36	0	3	52

SAN FRANCISCO, CALIF. (International Airport) 37°37'N., 122°23'W. Elevation (ground) 8 feet. WB-1961

Month	Air temperature (°F.)					Precipitation (inches)			Humidity (percent)		Wind (knots)			Percent of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days						
	Normal			Extreme												Sunrise to sunset						
	Daily maximum	Daily minimum	Monthly	Record highest	Record lowest	Normal total	Maximum in 24 hrs.	Snow, sleet, mean total	10:00 a.m. PST	4:00 p.m. PST	Mean speed	Prevailing direction	Maximum speed and direction			Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, sleet 1.0 inch or more	Thunderstorms	Heavy fog
(a)				34	34		34	34	22	22	34	34	24		20	34	34	34	34	34	34	24
Jan.	55.8	39.9	47.9	72	24	3.47	2.07	T	78	69	6.0	WNW	52 SW		6.2	8	9	14	11	0	*	4
Feb.	58.9	42.6	50.8	78	25	3.44	2.31	T	75	68	7.4	WNW	54 SW		5.8	9	7	12	10	0	*	3
Mar.	61.3	44.2	52.8	85	30	2.44	2.11	T	69	66	8.9	WNW	45 NW		5.6	10	9	12	9	0	*	1
Apr.	62.8	45.4	54.1	88	31	1.29	2.66	0.0	69	68	10.4	WNW	42 W		5.2	11	10	9	6	0	*	*
May	65.3	47.8	56.6	94	36	0.40	1.54	0.0	67	67	11.5	W	49 W		4.7	13	10	8	3	0	*	*
June	68.9	50.4	59.7	106	41	0.13	0.49	0.0	66	65	12.3	W	42 W		3.7	17	8	5	1	0	*	*
July	69.2	51.5	60.4	104	43	0.01	0.15	0.0	69	66	12.0	NW	43 W		3.1	20	8	3	*	0	*	*
Aug.	69.6	51.6	60.6	92	42	0.01	0.21	0.0	70	68	11.2	NW	39 WNW		3.5	19	9	3	*	0	*	*
Sep.	72.2	51.7	62.0	102	38	0.11	2.30	0.0	68	63	9.6	NW	42 S		3.1	18	9	3	1	0	*	1
Oct.	69.4	49.3	59.4	95	34	0.92	1.57	0.0	69	64	8.0	WNW	44 SW		4.0	16	9	6	4	0	*	2
Nov.	64.1	44.7	54.4	84	25	1.62	1.63	0.0	72	65	6.0	WNW	48 SSW		5.1	12	9	9	6	0	*	3
Dec.	56.9	41.6	49.3	75	20	3.59	3.33	T	77	70	5.6	WNW	46 S		6.0	9	8	14	10	*	*	5
Year	64.5	46.7	55.6	106	20	17.43	3.33	T	71	67	9.0	WNW	54 SW		4.7	162	105	98	62	*	2	21

EUREKA, CALIF. (Post Office Building) 40°48'N., 124°10'W. Elevation (ground) 43 feet. WB-1961

Month	Air temperature (°F.)					Precipitation (inches)			Humidity (percent)		Wind (knots)			Percent of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days						
	Normal			Extreme												Sunrise to sunset						
	Daily maximum	Daily minimum	Monthly	Record highest	Record lowest	Normal total	Maximum in 24 hrs.	Snow, sleet, mean total			Mean speed	Prevailing direction	Maximum speed and direction			Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, sleet 1.0 inch or more	Thunderstorms	Heavy fog
(a)				51	51		51	51			51	51	51	51	19	51	51	51	51	51	51	51
Jan.	53.6	40.8	47.2	75	25	6.20	4.42	0.2			6.1	SE	47 S	40	7.3	6	6	19	17	*	1	4
Feb.	54.6	42.2	48.4	85	27	5.65	4.88	T			6.3	SE	42 SW	44	7.3	6	6	16	14	0	1	3
Mar.	55.0	43.2	49.1	78	29	4.64	3.09	T			6.6	N	42 SW	49	7.4	6	8	17	15	0	*	2
Apr.	56.0	45.2	50.6	79	32	2.88	2.38	T			7.0	N	43 N	53	7.2	6	9	15	12	0	*	2
May	57.7	48.1	52.9	84	37	1.82	2.23	0.0			6.9	N	35 NW	54	7.0	7	10	14	9	0	*	1
June	60.2	51.0	55.6	85	41	0.66	1.73	0.0			6.4	N	34 NW	57	6.4	8	10	12	5	0	*	2
July	60.6	52.2	56.4	76	45	0.09	1.18	0.0			5.9	NW	30 N	51	6.6	6	12	13	2	0	*	3
Aug.	61.3	52.7	57.0	73	44	0.11	0.89	0.0			5.0	NW	30 N	46	7.0	5	11	15	2	0	*	5
Sep.	61.5	50.9	56.2	85	41	0.67	1.18	0.0			4.8	N	38 N	52	5.9	9	9	12	5	0	*	7
Oct.	60.0	48.4	54.2	82	34	2.70	5.83	0.0			4.9	N	37 SW	48	6.5	9	8	14	9	0	*	9
Nov.	57.8	44.8	51.3	77	29	4.64	4.55	0.0			5.1	SE	37 S	42	7.1	7	7	16	12	0	1	7
Dec.	55.0	42.2	48.6	70	22	6.09	4.17	T			5.6	SE	49 S	39	7.5	6	7	18	15	0	1	4
Year	57.8	46.8	52.3	85	22	36.15	5.83	0.2			5.9	N	49 S	49	6.9	81	103	181	118	*	4	49

ASTORIA, OREG. (Clatsop County Airport) 46°09'N., 123°53'W. Elevation (ground) 8 feet. WB-1961

Month	Air temperature (°F.)					Precipitation (inches)			Humidity (percent)		Wind (knots)			Percent of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days						
	Normal			Extreme												Sunrise to sunset						
	Daily maximum	Daily minimum	Monthly	Record highest	Record lowest	Normal total	Maximum in 24 hrs.	Snow, sleet, mean total	10:00 a.m. PST	4:00 p.m. PST	Mean speed	Prevailing direction	Maximum speed and direction			Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, sleet 1.0 inch or more	Thunderstorms	Heavy fog
(a)				8	8		8	8	8	8	8	8			8	8	8	8	8	8	8	8
Jan.	44.0	36.1	40.1	65	15	10.66	3.55	1.7	84	80	7.4	E			8.5	3	3	25	24	1	1	4
Feb.	48.4	37.8	43.1	67	20	9.44	2.86	0.1	82	77	7.5	ESE			8.5	2	3	23	21	0	*	2
Mar.	50.8	39.8	45.3	68	24	8.27	2.66	1.3	77	71	7.3	SE			8.2	3	4	24	22	1	1	2
Apr.	55.1	44.2	49.7	83	29	5.15	1.34	T	74	70	7.0	WNW			8.0	4	4	22	18	0	*	3
May	58.8	48.2	53.5	86	30	3.53	1.61	0.0	73	69	6.9	NW			7.8	3	8	20	16	0	1	2
June	63.2	52.0	57.6	93	38	2.66	1.66	0.0	75	71	6.8	NW			7.8	3	6	21	15	0	1	1
July	66.7	54.8	60.8	100	42	1.07	1.43	0.0	75	69	7.3	NW			6.4	6	11	14	7	0	1	1
Aug.	67.6	55.9	61.8	82	43	1.45	1.64	0.0	77	71	6.6	NW			6.6	6	11	14	9	0	*	4
Sep.	66.8	53.8	60.3	92	37	3.04	2.63	0.0	75	70	6.2	SE			6.4	9	6	15	11	0	1	5
Oct.	59.2	49.0	54.1	78	30	7.15	3.47	0.0	81	75	6.4	SE			7.3	6	6	19	18	0	1	6
Nov.	51.6	42.6	47.1	66	15	10.36	3.48	0.3	82	77	7.3	SE			7.8	4	5	21	18	*	1	4
Dec.	46.7	38.6	42.7	62	22	13.21	3.03	0.3	86	81	7.7	ESE			8.7	2	3	26	22	*	1	6
Year	56.6	46.1	51.4	100	15	75.99	3.55	3.7	78	73	7.0	SE			7.7	51	70	244	201	2	9	40

PORTLAND, OREG. (Customhouse Building) 45°32'N., 122°40'W. Elevation (ground) 30 feet. WB-1961

Month	Air temperature (°F.)					Precipitation (inches)			Humidity (percent)		Wind (knots)			Percent of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days						
	Normal			Extreme												Sunrise to sunset						
	Daily maximum	Daily minimum	Monthly	Record highest	Record lowest	Normal total	Maximum in 24 hrs.	Snow, sleet, mean total	10:00 a.m. PST	4:00 p.m. PST	Mean speed	Prevailing direction	Maximum speed and direction			Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, sleet 1.0 inch or more	Thunderstorms	Heavy fog
(a)				59	59	59	59	21	21	21	13	13	13	12	13	13	13	13	59	59	21	19
Jan.	44.2	34.7	39.5	65	6	5.43	4.61	5.2	81	77	9.0	ESE	47 S	22	8.5	3	3	25	19	2	*	3
Feb.	49.5	38.0	43.8	68	7	4.87	2.67	1.7	80	69	7.6	ESE	53 SW	30	8.5	2	3	23	16	1	*	2
Mar.	55.6	41.1	48.4	83	22	4.15	2.50	0.6	71	61	7.3	ESE	43 S	34	8.5	2	4	25	17	*	*	2
Apr.	62.2	44.9	53.6	93	30	2.43	1.96	0.1	67	54	6.2	NW	52 S	47	7.5	5	5	20	14	*	1	1
May	68.6	49.6	59.1	99	36	1.87	1.83	T	66	54	5.6	NW	36 SW	48	7.3	4	7	20	12	0	2	*
June	73.1	54.4	63.8	102	41	1.62	2.16	0.0	66	49	5.6	NW	35 SW	48	6.9	6	6	18	9	0	1	*
July	79.2	57.8	68.5	107	43	0.42	1.32	0.0	62	46	6.3	NW	27 S	69	4.3	14	9	8	3	0	1	*
Aug.	78.8	57.9	68.4	102	44	0.61	1.29	0.0	65	48	5.7	NW	25 SW	61	5.2	11	10	10	4	0	1	*
Sep.	73.4	54.4	63.9	102	35	1.83	2.88	0.0	67	50	5.1	NW	33 SW	58	5.7	10	8	12	7	0	1	3
Oct.	63.5	48.7	56.1	90	29	3.53	2.43	T	79	66	5.4	ESE	43 SW	38	7.2	5	7	19	12	0	*	7
Nov.	52.7	41.7	47.2	71	15	6.05	4.43	0.1	82	74	6.9	ESE	49 SW	32	8.0	4	4	22	17	*	*	6
Dec.	46.8	37.9	42.4	65	3	7.10	5.01	1.2	84	79	8.3	ESE	50 S	21	9.0	1	3	27	19	*	*	5
Year	62.3	46.8	54.6	107	3	39.91	5.01	8.9	73	61	6.6	NW	53 SW	45	7.2	67	69	229	152	3	7	29

TATOOSH ISLAND, WASH. 48°23'N., 124°44'W. Elevation (ground) 101 feet. WB-1961

Month	Air temperature (°F.)					Precipitation (inches)			Humidity (percent)		Wind (knots)			Percent of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days						
	Normal			Extreme												Sunrise to sunset						
	Daily maximum	Daily minimum	Monthly	Record highest	Record lowest	Normal total	Maximum in 24 hrs.	Snow, sleet, mean total	10:00 a.m. PST	4:00 p.m. PST	Mean speed	Prevailing direction	Maximum speed and direction			Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, sleet 1.0 inch or more	Thunderstorms	Heavy fog
(a)				59	59		59	59	44	59	30	22	59	51	55	59	59	59	59	59	59	59
Jan.	44.9	39.0	42.0	64	14	10.19	3.67	3.6	82	83	17.5	E	76 S	26	8.0	4	4	23	22	1	1	1
Feb.	46.5	39.8	43.2	64	16	8.70	4.57	1.5	81	80	15.4	E	73 NE	35	7.5	5	4	19	18	*	*	1
Mar.	48.3	41.0	44.7	69	25	7.82	4.76	1.0	81	80	13.6	E	79 E	39	7.5	5	6	20	20	*	*	1
Apr.	51.5	43.5	47.5	75	33	5.23	3.70	T	80	80	11.7	W	63 SW	44	7.3	5	7	18	17	0	*	2
May	54.8	46.9	50.9	81	36	3.31	2.22	T	82	81	10.0	W	57 S	46	7.2	5	8	18	14	0	*	3
June	57.7	50.2	54.0	84	43	2.58	2.75	0.0	86	84	8.7	SW	61 S	45	7.2	4	8	18	12	0	*	5
July	59.2	51.7	55.5	88	44	1.99	3.72	0.0	89	87	8.7	S	46 S	48	6.8	6	8	17	10	0	*	11
Aug.	59.5	51.9	55.7	78	45	2.01	2.30	0.0	90	90	8.5	S	51 SW	44	7.0	5	8	18	10	0	*	16
Sep.	58.7	50.2	54.5	80	40	3.64	3.79	0.0	87	86	9.7	S	59 NE	47	6.5	7	7	16	11	0	*	10
Oct.	55.5	48.2	51.9	77	33	8.72	5.91	T	85	85	12.9	E	63 S	38	7.0	6	7	18	17	0	1	6
Nov.	50.6	44.1	47.4	68	19	9.52	4.38	0.4	83	84	15.8	E	82 S	27	7.9	3	5	22	21	*	1	2
Dec.	47.1	41.1	44.1	61	20	12.04	4.03	0.8	83	84	17.1	E	74 S	24	8.0	3	5	23	23	*	1	1
Year	52.9	45.6	49.3	88	14	75.75	5.91	7.3	84	84	12.5	E	82 S	40	7.3	58	77	230	195	3	5	59

SEATTLE, WASH. (Federal Office Building) 47°36'N., 122°20'W. Elevation (ground) 14 feet. WB-1961

Month	Air temperature (°F.)					Precipitation (inches)			Humidity (percent)		Wind (knots)			Percent of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days						
	Normal			Extreme												Sunrise to sunset						
	Daily maximum	Daily minimum	Monthly	Record highest	Record lowest	Normal total	Maximum in 24 hrs.	Snow, sleet, mean total	10:00 a.m. PST	4:00 p.m. PST	Mean speed	Prevailing direction	Maximum speed and direction			Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, sleet 1.0 inch or more	Thunderstorms	Heavy fog
(a)				28	28		28	28	22	22	11	12	28	28	24	24	24	24	28	28	24	
Jan.	45.2	36.2	40.7	66	11	4.49	2.46	4.7	80	73	6.8	S	55 SW	28	8.0	3	5	23	19	2	*	
Feb.	48.8	38.1	43.5	70	12	3.74	2.69	1.4	77	68	7.0	S	56 S	33	7.7	3	6	19	16	*	*	
Mar.	53.4	40.5	47.0	75	22	3.06	2.32	0.8	70	59	7.5	S	52 SW	42	7.4	4	8	19	16	*	*	
Apr.	59.4	44.1	51.8	87	31	1.94	1.53	T	63	52	7.2	S	56 S	47	6.9	5	9	16	13	0	*	
May	65.6	48.9	57.3	92	35	1.61	1.35	0.0	62	50	6.7	S	39 SW	52	6.4	7	10	14	11	0	1	
June	70.2	53.4	61.8	100	45	1.25	1.08	0.0	63	51	6.6	S	47 SW	49	6.4	7	8	15	9	0	1	
July	75.1	56.1	65.6	100	48	0.52	1.22	0.0	62	46	6.3	NNW	33 SW	63	4.9	12	10	9	5	0	1	
Aug.	74.2	56.2	65.2	97	48	0.87	0.79	0.0	67	50	5.9	NNW	30 SW	56	5.3	10	10	11	6	0	1	
Sep.	68.8	53.2	61.0	92	42	1.56	1.91	0.0	71	56	5.6	SSE	48 SW	53	5.6	9	8	13	8	0	1	
Oct.	60.5	48.2	54.4	78	30	3.08	1.97	T	79	68	5.9	SSE	55 S	36	7.2	5	8	18	14	0	1	
Nov.	51.8	42.1	47.0	70	13	4.46	3.20	0.8	81	75	6.2	SSE	50 SW	29	8.0	3	6	21	17	*	*	
Dec.	47.3	38.9	43.1	65	21	5.34	3.31	0.7	83	77	6.6	SSE	52 SW	24	8.1	3	5	23	19	*	*	
Year	60.0	46.3	53.2	100	11	31.92	3.31	8.4	72	60	6.5	S	56 S	45	6.8	71	93	201	153	3	6	

HONOLULU, HAWAII (Federal Building) 21°19'N., 157°52'W. Elevation (ground) 12 feet. WB-1961

Month	Air temperature (°F.)					Precipitation (inches)			Humidity (percent)		Wind (knots)			Percent of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days						
	Normal			Extreme												Sunrise to sunset						
	Daily maximum	Daily minimum	Monthly	Record highest	Record lowest	Normal total	Maximum in 24 hrs.	Snow, sleet, mean total	8:00 a.m. HST	2:00 p.m. HST	Mean speed	Prevailing direction	Maximum speed and direction			Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, sleet 1.0 inch or more	Thunderstorms	Heavy fog
(a)				39	39		39	39	15	15	12	12	10	9	15	12	12	12	39	39	12	12
Jan.	76.7	67.2	72.0	83	57	4.31	8.06	0.0	80	61	8.7	ENE	58 SW	66	5.2	11	12	8	12	0	1	0
Feb.	76.7	67.2	72.0	82	58	2.49	8.07	0.0	78	61	9.6	ENE	55 W	63	6.0	7	12	9	12	0	1	0
Mar.	76.8	67.6	72.2	83	58	2.30	17.41	0.0	74	58	10.0	ENE	51 SE	73	5.8	8	14	9	13	0	1	0
Apr.	77.7	68.8	73.3	83	59	2.05	7.98	0.0	71	57	10.6	ENE	35 NE	73	6.1	7	12	11	12	0	*	0
May	79.5	70.6	75.1	84	64	1.01	2.14	0.0	69	56	11.2	ENE	30 E	73	6.0	8	13	10	11	0	*	0
June	81.3	72.4	76.9	86	64	0.63	0.81	0.0	68	56	11.6	ENE	34 E	75	5.5	7	17	6	11	0	0	0
July	82.2	73.5	77.9	87	68	0.86	1.22	0.0	69	56	11.9	ENE	30 E	77	5.1	9	18	4	13	0	0	0
Aug.	82.8	74.1	78.5	88	68	1.09	2.53	0.0	70	56	12.2	ENE	45 SE	76	5.2	8	17	6	13	0	0	0
Sep.	82.9	73.7	78.3	88	69	1.34	6.02	0.0	70	55	10.3	ENE	30 NE	77	4.9	10	15	5	12	0	*	0
Oct.	82.0	72.9	77.5	87	66	2.28	7.06	0.0	72	58	9.6	ENE	35 SE	72	5.5	8	14	9	12	0	1	0
Nov.	79.7	70.7	75.2	86	62	2.08	6.18	0.0	74	61	9.9	ENE	56 NE	67	5.5	8	13	9	13	0	1	0
Dec.	77.7	68.9	73.3	85	59	3.48	6.54	0.0	75	61	9.9	ENE	51 NE	61	5.4	9	13	9	14	0	1	0
Year	79.7	70.6	75.2	88	57	23.92	17.41	0.0	73	58	10.4	ENE	58 SW	71	5.5	100	170	95	148	0	5	0

HILO, HAWAII, (General Lyman Airport) 19°43'N., 155°04'W. Elevation (ground) 31 feet. WB-1961

Month	Air temperature (°F.)					Precipitation (inches)			Humidity (percent)		Wind (knots)			Percent of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days						
	Normal			Extreme												Sunrise to sunset						
	Daily maximum	Daily minimum	Monthly	Record highest	Record lowest	Normal total	Maximum in 24 hrs.	Snow, sleet, mean total	8:00 a.m. HST	2:00 p.m. HST	Mean speed	Prevailing direction	Maximum speed and direction			Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, sleet 1.0 inch or more	Thunderstorms	Heavy fog
(a)				15	15		19	19	12	12	12	12		11	15	15	15	15	19	19	16	16
Jan.	78.4	62.4	70.4	89	55	14.13	9.94	0.0	80	67	6.5	SW		46	6.8	5	11	15	19	0	*	0
Feb.	79.0	62.4	70.7	88	55	9.48	13.41	0.0	82	69	6.8	SW		41	7.1	3	10	15	19	0	2	0
Mar.	78.5	63.1	70.8	88	55	15.72	9.18	0.0	81	67	6.8	SW		41	7.7	2	10	19	23	0	1	0
Apr.	79.2	64.0	71.6	87	56	13.27	9.39	0.0	82	69	6.5	WSW		33	8.2	1	7	22	25	0	1	0
May	81.1	65.1	73.1	85	58	9.00	5.94	0.0	81	69	6.3	WSW		31	8.2	1	9	21	25	0	*	0
June	82.5	66.3	74.4	88	60	6.75	2.25	0.0	79	65	6.3	WSW		42	7.5	2	11	17	24	0	*	0
July	82.6	67.0	74.8	88	62	9.89	5.42	0.0	82	67	6.3	WSW		44	7.6	1	12	18	28	0	*	0
Aug.	83.1	67.7	75.4	93	63	11.92	9.27	0.0	83	70	6.3	WSW		38	7.9	1	9	21	27	0	*	0
Sep.	83.0	67.5	75.3	92	62	10.42	6.02	0.0	80	66	6.2	WSW		41	7.1	2	12	16	24	0	*	0
Oct.	82.2	66.8	74.5	91	62	11.02	8.88	0.0	81	68	6.0	SW		40	7.4	2	11	18	25	0	1	0
Nov.	80.3	65.7	73.0	88	58	12.39	15.59	0.0	83	71	5.8	WSW		32	7.6	2	9	19	24	0	1	0
Dec.	78.8	64.0	71.4	85	56	15.99	10.50	0.0	82	71	6.4	SW		37	7.4	3	10	18	24	0	*	0
Year	80.7	65.2	73.0	93	55	139.98	15.59	0.0	81	68	6.3	WSW		39	7.5	25	121	219	287	0	6	0

LIHUE, HAWAII (Lihue Airport) 21°59'N., 159°21'W. Elevation (ground) 115 feet. WB-1961

Month	Air temperature (°F.)					Precipitation (inches)			Humidity (percent)		Wind (knots)			Percent of possible sunshine	Mean sky cover sunrise to sunset	Mean number of days						
	Normal			Extreme												Sunrise to sunset						
	Daily maximum	Daily minimum	Monthly	Record highest	Record lowest	Normal total	Maximum in 24 hrs.	Snow, sleet, mean total	8:00 a.m. HST	2:00 p.m. HST	Mean speed	Prevailing direction	Maximum speed and direction			Clear	Partly cloudy	Cloudy	Precipitation .01 inch or more	Snow, sleet 1.0 inch or more	Thunderstorms	Heavy fog
(a)				11	11		11	12	12	12	11	11	11	11	12	11	11	11	11	12	11	12
Jan.	77.4	62.7	70.1	84	53	6.23	11.09	0.0	84	67	8.9	ENE	31 SW	51	5.9	8	12	11	15	0	1	0
Feb.	77.7	62.5	70.1	86	53	4.44	7.28	0.0	82	67	10.0	NE	30 E	51	6.4	6	11	11	16	0	1	0
Mar.	77.7	63.5	70.6	85	51	4.07	4.74	0.0	79	65	9.9	NE	31 N	50	6.4	5	14	12	16	0	1	0
Apr.	78.2	65.7	72.0	87	56	3.03	1.50	0.0	76	66	10.4	NE	25 NE	47	7.1	4	12	14	15	0	*	0
May	79.8	68.3	74.1	85	59	2.51	3.30	0.0	75	65	10.8	NE	43 NE	53	6.9	3	14	14	16	0	*	0
June	81.2	71.1	76.2	88	64	1.65	0.80	0.0	75	65	10.9	NE	26 NE	61	6.6	3	15	12	17	0	0	0
July	82.4	72.4	77.4	88	65	1.87	5.04	0.0	76	65	10.9	NE	27 NE	61	6.5	3	18	10	20	0	*	0
Aug.	83.3	72.9	78.1	89	66	2.27	5.43	0.0	76	66	11.2	NE	63 NE	61	6.7	3	16	12	19	0	*	0
Sep.	83.6	72.0	77.8	89	65	2.20	1.98	0.0	77	65	9.7	NE	26 NE	68	5.8	6	16	8	16	0	1	0
Oct.	82.6	70.3	76.5	90	63	4.63	4.99	0.0	79	67	9.3	NE	28 E	59	6.2	5	14	12	19	0	1	0
Nov.	79.7	67.5	73.6	86	57	4.24	11.20	0.0	81	69	10.2	NE	37 S	52	6.4	4	14	12	18	0	1	0
Dec.	77.8	65.2	71.5	85	52	5.35	5.40	0.0	80	68	9.9	NE	50 NE	49	6.5	5	14	12	18	0	1	0
Year	80.1	67.8	74.0	90	51	42.49	11.20	0.0	78	66	10.2	NE	63 NE	55	6.5	55	170	140	205	0	8	0

MEAN SURFACE WATER TEMPERATURES AND SALINITIES

Station	Years	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sept.		Oct.		Nov.		Dec.		Mean	
		Temp. °F	Sal. °/₀₀	Temp. °F	Sal. °/₀₀	Temp. °F	Sal. °/₀₀	Temp. °F	Sal. °/₀₀	Temp. °F	Sal. °/₀₀	Temp. °F	Sal. °/₀₀	Temp. °F	Sal. °/₀₀	Temp. °F	Sal. °/₀₀	Temp. °F	Sal. °/₀₀	Temp. °F	Sal. °/₀₀	Temp. °F	Sal. °/₀₀	Temp. °F	Sal. °/₀₀	Temp. °F	Sal. °/₀₀
San Diego, Calif. ..... 32°42'N., 117°14'W.	4	56.2	33.2	56.7	33.2	58.2	33.3	59.3	33.5	62.5	33.7	64.0	33.8	67.2	34.1	67.3	34.0	65.1	33.8	63.0	33.5	59.7	33.6	58.1	33.3	61.4	33.6
La Jolla, Calif. ..... 32°52'N., 117°15'W.	47	57.2	33.6	57.0	33.5	58.0	33.5	59.8	33.6	62.7	33.6	65.3	33.7	68.0	33.7	69.2	33.7	66.7	33.6	64.3	33.6	61.3	33.6	59.0	33.6	62.4	33.6
Los Angeles (Outer Harbor), Calif. 33°43'N., 118°16'W.	39	56.7	33.2	57.2	33.1	58.1	33.3	59.4	33.5	61.1	33.6	63.8	33.7	66.0	33.7	66.9	33.7	65.7	33.7	64.2	33.6		33.6	58.6	33.5	61.6	33.5
Santa Monica, Calif. ..... 34°00'N., 118°30'W.	17	56.2	33.5	56.3	33.5	56.9	33.6	58.7	33.7	60.3	33.8	63.6	33.8	66.5	33.8	67.3	33.7	65.9	33.7	63.2	33.6	60.1	33.6	57.9	33.6	61.1	33.7
Avila Beach, Calif. ..... 35°10'N., 120°44'W.	17	53.7	33.5	53.5	33.1	53.2	33.6	53.9	34.0	54.7	34.0	56.6	34.1	58.8	34.1	59.6	34.1	59.3	34.0	58.1	33.8	56.1	33.6	54.8	33.6	56.0	33.8
San Francisco (Ft. Point), Calif. 37°48'N., 122°28'W.	41	50.8	28.8	51.7	27.2	53.1	26.7	54.5	27.1	55.6	28.0	57.3	28.9	58.7	31.0	59.6	32.0	60.2	32.4	59.0	32.1	55.5	30.7	52.4	30.3	55.7	29.6
Alameda, Calif. ..... 37°47'N., 122°18'W.	23	50.5	24.1	53.2	21.7	56.9	21.2	61.4	22.1	64.3	23.5	67.4	25.2	69.1	27.7	69.0	29.4	68.4	30.3	64.1	29.7	57.6	28.6	52.7	26.9	61.2	25.9
Crescent City, Calif. ..... 41°45'N., 124°12'W.	27	49.5	28.5	50.0	27.8	50.4	28.5	51.4	29.4	52.9	30.6	54.6	31.4	56.2	32.4	57.5	32.5	56.4	32.5	53.9	32.1	51.8	30.7	50.4	29.7	52.9	30.5
Astoria (Tongue Point), Oreg. 46°13'N., 123°46'W.	38	40.4	1.6	41.8	0.9	45.7	0.6	51.4	0.3	56.5	0.3	60.8	0.3	66.2	0.4	67.4	0.8	64.2	1.7	57.5	2.6	48.9	2.4	43.6	2.0	53.7	1.2
Tokeland, Willapa Bay, Wash. 46°42'N., 123°58'W.	5	44.6	20.1	44.0	21.7	47.9	21.2	51.4	21.6	55.8	23.7	60.5	23.8	63.3	26.3	63.6	28.9	60.3	29.0	55.9	28.8	49.9	26.0	46.8	23.7	53.7	24.6
Raymond, Willapa Bay, Wash. 46°41'N., 123°45'W.	7	44.2	6.4	45.0	6.8	48.2	5.9	53.5	7.5	59.8	8.8	64.2	11.5	68.5	15.8	68.4	20.8	64.7	19.5	58.3	17.9	48.9	11.4	46.0	8.0	55.8	11.6
Neah Bay, Wash. ..... 48°22'N., 124°37W.	27	45.2	30.4	45.3	30.3	46.2	30.7	48.6	30.8	51.3	31.2	53.0	31.4	53.2	32.1	52.8	32.3	52.2	32.3	51.1	31.8	49.0	31.1	47.0	30.4	49.6	31.2
Seattle (Elliott Bay), Wash., 47°36'N. 122°21'W.	40	47.5	28.2	46.7	28.1	46.7	27.6	47.9	27.1	50.4	27.1	53.2	27.5	55.3	28.5	55.8	29.1	55.2	29.7	53.8	29.8	51.5	29.4	49.4	28.9	51.1	28.4
Friday Harbor, Wash. ..... 48°33'N., 123°00'W.	17	45.4	30.3	44.8	30.3	45.2	30.4	46.6	30.4	48.5	30.3	50.3	30.1	51.7	29.8	51.9	30.2	51.0	30.4	49.6	30.8	48.1	30.7	46.9	30.4	48.3	30.3
Hilo, Hawaii ..... 19°44'N., 155°03'W.	16	70.7	24.6	70.7	24.1	70.3	23.3	70.6	22.5	71.1	22.1	72.0	23.1	72.6	22.7	73.2	22.9	73.5	23.8	73.5	24.2	72.7	2.43	71.5	23.7	71.9	23.4
Honolulu, Hawaii ..... 21°18'N., 157°52'W	18	76.0	34.2	76.0	34.5	75.9	34.5	76.6	34.8	77.6	34.8	78.7	34.9	79.8	34.9	80.2	34.9	80.5	34.9	80.4	34.9	78.8	34.8	77.0	34.8	78.1	34.7
Kaneohe Bay, Hawaii ..... 21°26'N., 157°48'W.	6	73.1	34.5	72.9	34.4	74.0	34.0	75.2	34.4	77.0	34.6	79.3	35.0	79.4	35.0	80.0	35.0	79.6	35.1	79.1	34.9	76.3	34.4	73.2	34.4	76.6	34.6
Midway Islands ..... 28°13'N., 177°22'W.	18	67.6	35.5	67.2	35.5	68.4	35.5	69.8	35.7	72.6	35.8	77.0	35.8	79.4	35.9	80.3	35.8	80.4	35.8	77.3	35.7	73.7	35.8	70.5	35.5	73.7	35.7

°/₀₀: This symbol denotes the salinity of sea water, and is defined as the number of grams of salts in 1,000 grams of sea water. For sea water temperature and salinity in greater detail, see Coast and Geodetic Survey Publication 31-3, Surface Water Temperature and Salinity, Pacific Coast, North and South America and Pacific Ocean Islands.

HOURS OF OPERATION OF FOG SIGNALS
(U.S. Coast Guard)

Light station	12 Calendar Years - 1950 thru 1961														Pre - 1950		
	Average													Max. 1 yr.	Ave.	For yrs.	Max. 1 yr.
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year				
Point Loma, Calif. 32°39.9'N., 117°14.5'W.	82	78	62	48	20	43	36	28	99	115	95	110	816	1291	423	32	859
Ballast Point, Calif. 32°41.2'N., 117°14.0'W.	46	45	32	25	7	17	14	10	48	62	59	68	433	660	224	40	619
Los Angeles, Calif. 33°42.5'N., 118°15.0'W.	117	97	75	56	33	46	62	68	105	127	141	157	1084	1889	805	32	2806
Point Vicente, Calif. 33°44.5'N., 118°24.6'W.	59	65	54	47	25	58	52	51	83	97	91	106	788	1442	482	5	573
Point Hueneme, Calif. 34°08.7'N., 119°12.5'W.	53	54	48	64	52	90	108	114	117	118	72	79	969	1343	534	33	1008
Anacapa Island, Calif. 34°00.9'N., 119°21.5'W.	70	67	52	90	73	111	142	142	129	143	89	88	1196	1705	954	13	1707
Point Conception, Calif. 34°26.9'N., 120°28.2'W.	50	44	33	42	47	91	104	118	102	94	54	61	840	1462	304	61	647
Point Arguello, Calif. 34°34.6'N., 120°39.2'W.	71	61	57	62	78	121	214	226	190	163	71	62	1376	2197	1014	44	1991
San Luis Obispo, Calif. 35°09.6'N., 120°45.6'W.	56	53	45	65	83	139	218	236	207	165	71	51	1389	1927	1106	57	2170
Piedras Blancas, Calif. 35°39.9'N., 121°17.1'W.	96	95	72	92	110	155	224	240	208	196	109	93	1690	2167	1028	44	1604
Point Sur, Calif. 36°18.4'N., 121°54.0'W.	47	67	49	55	72	117	241	232	163	143	77	44	1307	1996	1048	59	1958
Point Pinos, Calif. 36°38.2'N., 121°56.1'W.	49	60	49	56	48	103	185	203	156	153	98	68	1228	2321	756	9	1032
Pigeon Point, Calif. 37°10.9'N., 122°23.6'W.	86	89	68	71	65	107	206	196	181	176	117	94	1456	1963	863	65	1889
Point Montara, Calif. 37°32.2'N., 122°31.1'W.	45	54	44	41	48	81	147	154	115	128	84	60	1001	1672	914	65	1325
Farallon, Calif. 37°41.8'N., 123°00.1'W.	142	125	90	77	90	138	282	300	195	202	173	148	1962	2479	984	65	1886
San Francisco Lightship, Calif. 37°45.0'N., 122°41.5'W.	114	88	59	46	60	98	204	211	143	149	123	125	1420	1809	1066	46	1802
Point Bonita, Calif. 37°48.9'N., 122°31.7'W.	121	87	51	56	60	87	202	220	156	155	126	139	1460	2220	1041	65	1284
Alcatraz, Calif. 37°49.5'N., 122°25.2'W.	52	43	14	14	16	27	65	76	51	63	37	52	510	954	443	44	719
Carquinez Strait, Calif. 38°04.2'N., 122°14.6'W.	101	57	11	4	2	1	6	7	8	31	78	111	417	655	230	39	420

HOURS OF OPERATION OF FOG SIGNALS
(U.S. Coast Guard)

Light station	12 Calendar Years - 1950 thru 1961														Pre - 1950		
	Average													Max. 1 yr.	Ave.	For yrs.	Max. 1 yr.
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year				
Point Reyes, Calif. 37°59.7'N., 123°01.3'W.	136	124	115	92	119	162	360	395	253	243	179	136	2314	2920	1493	65	2360
Point Arena, Calif. 38°57.3'N., 123°44.4'W.	108	103	62	68	71	99	269	310	207	218	169	128	1812	2417	1109	65	1660
Point Cabrillo, Calif. 39°20.9'N., 123°49.5'W.	46	58	36	45	49	78	239	258	178	165	120	81	1353	1750	925	40	1833
Blunts Reef Lightship, Calif. 40°26.4'N., 124°30.3'W.	91	88	70	71	81	111	249	255	220	211	152	118	1717	2328	1149	39	1943
St. George Reef, Calif. 41°50.2'N., 124°22.5'W.	67	62	55	59	62	121	235	258	201	196	127	101	1544	1833	865	57	1348
Cape Arago, Oreg. 43°20.5'N., 124°22.5'W.	16	28	21	33	47	84	178	227	158	116	67	41	1016	1467	777	52	1793
Columbia River Lightship, Oreg. 46°11.1'N., 124°11.0'W.	77	69	48	37	26	53	60	90	78	80	79	57	754	1052	647	55	1230
Grays Harbor, Wash. 46°54.5'N., 124°07.0'W.	273	208	159	143	96	129	187	232	252	275	240	264	2458	3530	1308	20	2271
Destruction Island, Wash. 47°40.5'N., 124°29.1'W.	45	46	38	32	41	63	110	131	100	73	68	66	813	1262	619	56	1169
Cape Flattery, Wash. 48°23.5'N., 124°44.1'W.	92	77	61	62	58	104	160	219	146	111	85	98	1273	2721	769	65	1318
Slip Point, Wash. 48°15.9'N., 124°14.9'W.	64	38	25	17	23	38	68	100	96	85	68	63	685	1298	382	44	855
Ediz Hook, Wash. 48°08.4'N., 123°24.1'W.	37	33	17	20	17	30	72	97	110	89	50	46	618	991	492	46	894
Point Wilson, Wash. 48°08.7'N., 122°45.2'W.	29	18	15	14	16	34	73	79	98	73	45	24	518	802	441	65	833
West Point, Wash. 47°39.7'N., 122°26.1'W.	21	18	5	5	7	4	13	17	45	44	34	32	245	383	390	62	811
Browns Point, Wash. 47°18.4'N., 122°26.6'W.	79	39	27	13	11	7	11	21	64	112	82	94	560	868	804	44	1504
Burrows Island, Wash. 48°28.6'N., 122°42.7'W.	22	12	13	5	7	19	45	64	73	63	19	16	358	522	446	43	1004
Lime Kiln, Wash. 48°31.0'N., 123°09.1'W.	12	8	7	3	3	10	11	23	43	48	23	5	196	361	194	30	408
Patos Island, Wash. 48°47.3'N., 122°58.2'W.	45	17	18	3	6	9	7	14	44	67	44	33	307	653	255	55	526

TRANS-PACIFIC DISTANCES

June 15, 1963

Figure at intersection of columns opposite ports in question is the nautical mileage between the two. Example: San Francisco, Calif., is 2091 nautical miles from Honolulu, Hawaii.

Panama Canal (Pac. Ent.) 8°53.0'N., 79°31.0'W.	San Diego, Calif. 32°43.0'N., 117°10.5'W.	Long Beach, Calif. 33°46.2'N., 118°13.3'W.	Los Angeles, Calif. 33°45.0'N., 118°16.2'W.	San Francisco, Calif. 37°48.5'N., 122°24.0'W.	Astoria, Oreg. 46°11.7'N., 123°50.0'W.	Portland, Oreg. 45°33.0'N., 122°41.7'W.	CAPE FLATTERY, WASH. 48°26.0'N., 124°47.0'W.	SWIFTSURE BANK, WASH. 48°31.0'N., 125°00.0'W.	Seattle, Wash. 47°36.2'N., 122°20.3'W.	Ketchikan, Alaska 55°20.5'N., 131°38.7'W.	Sitka, Alaska 57°03.1'N., 135°20.5'W.	CAPE SPENCER, ALASKA 58°10.0'N., 136°38.3'W.	Seward, Alaska 60°06.0'N., 149°26.0'W.	Anchorage, Alaska 61°14.2'N., 149°53.3'W.	Kodiak, Alaska 57°47.1'N., 152°25.1'W.	UNIMAK PASS, ALASKA 54°20.0'N., 164°45.0'W.	Kuluk Bay, Alaska 51°51.6'N., 176°37.6'W.	Hilo, Hawaii 19°44.1'N., 155°03.5'W.	Kawaihae, Hawaii 20°02.3'N., 155°49.9'W.	Kahului, Hawaii 20°54.0'N., 156°28.2'W.	Honolulu, Hawaii 21°18.5'N., 157°52.3'W.	Pearl Harbor, Hawaii 21°20.0'N., 157°58.3'W.	Nawiliwili, Hawaii 21°57.4'N., 159°21.5'W.	Port Allen, Hawaii 21°54.1'N., 159°35.6'W.	Midway Islands 28°13.0'N., 177°22.0'W.
2867																										
2939	94																									
2939	95	3																								
3270	455	374	371																							
3803	989	908	904	567																						
3888	1074	992	989	652	85																					
3920	1104	1024	1020	683	153	238																				
--	--	--	--	--	--	--	10																			
4044	1228	1148	1144	807	278	362	124	134																		
4387	1575	1497	1493	1156	660	745	--	518	659*																	
4538	1723	1643	1639	1302	815	900	--	681	815	224																
4603	1787	1707	1703	1366	883	968	--	739	976*	307	85															
4940	2124	2043	2040	1702	1242	1327	--	1100	1234	682	494	422														
5117	2303	2223	2220	1882	1435	1520	--	1294	1428	892	708	641	274													
4924	2115	2034	2031	1693	1261	1346	--	1124	1258	742	564	505	175	242												
5228	2412	2331	2328	1990	1626	1711	--	1510	1644	1193	1027	987	652	888	505											
5604	2806	2725	2722	2403	2071	2156	--	1973	2107	1656	1490	1450	1115	1151	968	463										
4527	2175	2143	2140	2019	2214	2299	2260	--	2384	2398	2410	2447	2439	2542	2296	2126	2198									
4594	2219	2183	2180	2051	2235	2320	2276	--	2400	2405	2412	2445	2432	2535	2289	2110	2164	83								
4609	2212	2173	2170	2036	2207	2292	2245	--	2369	2361	2365	2398	2377	2479	2233	2044	2099	121	85							
4685	2278	2236	2233	2091	2246	2331	2285	--	2409	2383	2385	2411	2373	2477	2230	2028	2061	196	140	89						
4690	2283	2241	2238	2096	2251	2336	2290	--	2414	2388	2390	2416	2378	2482	2235	2024	2057	201	145	94	9					
4767	2330	2284	2281	2128	2262	2347	2289	--	2413	2368	2361	2388	2332	2440	2184	1963	1989	287	230	181	96	92				
4777	2347	2302	2299	2146	2281	2366	2308	--	2432	2387	2380	2407	2351	2459	2203	1972	1990	297	240	193	106	102	21			
5707	3097	3034	3031	2792	2724	2809	2694	--	2818	2570	2481	2472	2250	2305	2088	1680	1460	1338	1278	1232	1150	1146	1069	1042		

*Via inside passage

COASTWISE DISTANCES

SAN DIEGO, CALIF., TO CAPE FLATTERY, WASH.

June 15, 1963

Figure at intersection of columns opposite ports in question is the nautical mileage between the two. Example: San Francisco, Calif., is 652 nautical miles from Portland, Oreg.

San Diego, Calif. 32°43.0'N., 117°10.5'W.	Newport Beach, Calif. 33°37.1'N., 117°55.5'W.	Long Beach, Calif. 33°46.2'N., 118°13.3'W.	Los Angeles, Calif. 33°45.0'N., 118°16.2'W.	Port Hueneme, Calif. 34°09.0'N., 119°12.4'W.	Santa Barbara, Calif. 34°24.5'N., 119°41.1'W.	Port San Luis, Calif. 35°10.4'N., 120°44.8'W.	Monterey, Calif. 36°36.5'N., 121°53.0'W.	San Francisco, Calif. 37°48.5'N., 122°24.0'W.	Oakland, Calif. 37°48.2'N., 122°19.5'W.	Stockton, Calif. 37°57.2'N., 121°18.8'W.	Sacramento, Calif. 38°33.8'N., 121°33.0'W.	Eureka, Calif. 40°47.8'N., 124°11.2'W.	Crescent City, Calif. 41°44.5'N., 124°11.4'W.	Coos Bay, Oreg. 43°22.4'N., 124°12.5'W.	Gardiner, Oreg. 43°43.9'N., 124°06.8'W.	Florence, Oreg. 43°58.0'N., 124°06.3'W.	Newport, Oreg. 44°37.8'N., 124°03.1'W.	Depoe Bay, Oreg. 44°48.6'N., 124°03.6'W.	Garibaldi, Oreg. 45°33.3'N., 123°55.1'W.	Astoria, Oreg. 46°11.7'N., 123°50.0'W.	Longview, Wash. 46°06.3'N., 122°57.7'W.	Vancouver, Wash. 45°37.6'N., 122°41.3'W.	Portland, Oreg. 45°33.0'N., 122°41.7'W.	South Bend, Wash. 46°40.1'N., 123°47.5'W.	Aberdeen, Wash. 46°58.4'N., 123°48.5'W.	CAPE FLATTERY, WASH. 48°26.0'N., 124°47.0'W.
78																											
94	25																										
95	27	3																									
147	81	66	62																								
174	108	94	90	29																							
259	193	179	175	116	91																						
370	304	290	286	228	203	121																					
455	389	374	371	312	287	205	96																				
458	392	377	374	315	290	208	100	3																			
526	460	445	442	383	358	276	167	75	78																		
530	464	449	446	387	362	280	171	79	82	75																	
653	587	572	569	510	485	403	294	232	235	303	307																
704	638	624	620	561	537	455	346	283	287	354	358	64															
817	751	736	733	674	649	567	459	396	399	467	471	180	125														
832	766	751	748	689	664	582	474	411	414	482	486	195	140	42													
848	782	768	764	706	681	599	490	427	430	498	502	212	156	59	36												
881	815	800	797	737	713	631	522	459	463	531	534	244	188	92	69	43											
891	825	810	807	748	723	641	532	469	473	541	544	254	199	101	78	54	16										
937	871	857	853	794	770	687	579	516	520	588	591	301	245	150	127	102	63	50									
989	922	908	904	845	821	739	630	567	570	639	642	352	296	201	178	153	115	101	58								
1034	967	953	949	890	866	783	675	612	615	684	687	397	341	246	223	198	160	146	103	45							
1070	1003	988	985	925	901	819	710	647	651	719	722	432	377	281	258	234	196	182	138	80	34						
1074	1007	992	989	930	905	823	714	652	655	723	727	436	381	285	262	238	200	186	142	85	39	13					
1019	953	939	935	876	852	769	661	598	601	670	673	383	327	232	209	184	146	133	90	63	108	143	147				
1031	965	951	947	888	864	781	673	610	613	682	685	395	339	244	221	196	158	144	102	75	119	155	159	53			
1104	1038	1024	1020	961	937	854	746	683	686	755	758	468	411	321	298	273	235	222	179	153	198	234	238	131	117		

C.P.7

SAN FRANCISCO BAY AREA DISTANCES

CALIFORNIA

June 15, 1963

Figure at intersection of columns opposite ports in question is the nautical mileage between the two. Example: Sacramento, Calif., is 74 nautical miles from Napa, Calif.

	San Francisco Bay								San Pablo Bay			Suisun Bay			San Joaquin R.	Sacramento River			
	San Francisco 37°48.5'N., 122°24.0'W.	Hunters Point 37°43.1'N., 122°21.5'W.	Redwood City 37°30.8'N., 122°12.5'W.	Oakland 37°48.2'N., 122°19.5'W.	Richmond 37°54.6'N., 122°21.7'W.	Sausalito 37°51.6'N., 122°28.6'W.	San Rafael 37°58.1'N., 122°30.7'W.	Petaluma 38°14.1'N., 122°38.2'W.	Vallejo 38°05.3'N., 122°15.3'W.	Napa 38°17.7'N., 122°16.9'W.	Benicia 38°02.4'N., 122°08.2'W.	Pittsburg 38°02.1'N., 121°52.6'W.	Antioch 38°01.1'N., 121°48.7'W.	Stockton 37°57.2'N., 121°18.8'W.	Hills Ferry 37°20.4'N., 120°58.5'W.	Rio Vista 38°09.3'N., 121°41.3'W.	Sacramento 38°33.8'N., 121°33.0'W.	Knights Landing 38°48.1'N., 121°43.1'W.	Colusa 39°13.0'N., 122°00.0'W.	Chico Landing 39°42.6'N., 121°56.6'W.
6																			
22	16																		
3	7	22																	
11	17	32	14																
5	11	27	8	7															
13	19	35	16	9	11														
33	39	54	36	29	31	27													
23	29	44	26	19	21	17	28												
37	43	58	40	34	36	32	43	15											
27	33	49	30	24	25	21	33	8	22										
40	46	62	43	37	39	35	46	21	36	14									
44	50	65	47	40	42	38	50	24	39	17	3								
75	81	96	78	71	73	69	81	55	70	48	35	31							
147	153	168	149	143	145	141	153	127	142	120	107	103	74						
52	58	73	55	49	51	47	58	33	48	26	14	17	48	100					
78	84	100	81	75	77	73	85	59	74	52	40	44	75	127	27				
107	113	129	110	104	106	102	114	88	103	81	69	73	84	156	56	29			
155	161	177	158	152	154	150	162	136	151	129	117	121	132	204	104	77	47		
197	203	219	200	194	196	192	204	178	193	171	159	163	174	246	146	119	89	42	

DISTANCES ON COLUMBIA RIVER SYSTEM

June 15, 1963

Figure at intersection of columns opposite ports in question is the nautical mileage between the two. Example: Astoria, Oreg., is 85 nautical miles from Portland, Oreg.

Columbia River	Columbia River Mouth 46°14.8'N., 124°05.5'W.	Ilwaco, Wash. 46°18.3'N., 124°02.2'W.	Warrenton, Oreg. 46°10.1'N., 123°55.0'W.	Astoria, Oreg. 46°11.7'N., 123°50.0'W.	Longview, Wash. 46°06.3'N., 122°57.7'W.	St. Helens, Oreg. 45°51.7'N., 122°47.6'W.	Vancouver, Wash. 45°37.6'N., 122°41.3'W.	Bonneville Lock & Dam 45°38.3'N., 121°56.8'W.	Hood River (town), Oreg. 45°43.0'N., 121°30.0'W.	The Dalles Lock & Dam 45°36.9'N., 121°08.3'W.	John Day Lock & Dam Site 45°42.9'N., 120°41.5'W.	Arlington, Oreg. 45°43.6'N., 120°12.2'W.	Umatilla, Oreg. 45°55.4'N., 119°20.5'W.	McNary Lock & Dam 45°56.4'N., 119°17.9'W.	Port of Walla Walla, Wash. 46°06.0'N., 118°55.3'W.	Pasco, Wash. 46°13.2'N., 119°05.9'W.	Richland, Wash. 46°16.5'N., 119°16.1'W.	Portland, Oreg. 45°33.0'N., 122°41.7'W.	Oregon City, Oreg. 45°21.5'N., 122°36.5'W.	Salem, Oreg. 44°56.2'N., 123°03.1'W.	Albany, Oreg. 44°38.3'N., 123°06.2'W.	Corvallis, Oreg. 44°34.0'N., 123°15.3'W.	Harrisburg, Oreg. 44°16.0'N., 123°10.2'W.	Ice Harbor Dam, Wash. 46°15.1'N., 118°52.7'W.	Central Ferry, Wash. 46°37.6'N., 117°46.6'W.	Lewiston, Idaho 46°25.1'N., 116°59.9'W.	Johnson Bar Landing, Idaho 45°27.6'N., 116°33.8'W.
6																													
11	12																												
12	13	4																											
58	59	50	45																										
75	76	67	62	17																									
92	93	84	80	34	20																								
126	127	118	114	68	55	35																							
148	149	140	136	90	76	56	22																						
166	167	159	154	108	95	75	40	18																					
188	189	180	176	130	117	96	62	40	22																				
210	211	202	198	152	138	118	84	62	44	22																			
251	252	244	239	193	180	160	125	103	85	63	42																		
254	254	246	241	195	182	162	127	106	87	65	44	2																	
276	276	268	263	217	204	184	149	128	109	87	66	24	22																
285	286	277	273	227	214	193	159	137	119	97	75	34	32	10															
293	294	285	281	235	222	202	167	145	127	105	83	42	40	18	8														
97	98	89	85	39	25	13	47	69	87	109	130	172	174	196	206	214													
110	111	103	98	52	39	26	61	82	101	123	144	186	188	210	220	228	14												
162	163	154	149	104	90	77	112	134	152	174	195	237	239	261	271	279	65	51											
192	193	184	180	134	121	108	142	164	183	204	226	268	270	292	301	309	96	82	31										
203	203	195	190	144	131	118	153	174	193	215	236	278	280	302	312	320	106	92	41	10									
230	230	222	217	171	158	145	180	201	220	242	263	305	307	329	339	347	133	119	68	37	27								
291	292	283	278	233	219	199	164	143	124	102	81	39	37	15	12	20	211	225	276	307	317	344							
354	355	346	342	296	282	262	228	206	188	166	144	103	101	79	75	83	275	288	340	370	380	407	63						
404	404	396	391	345	332	312	277	256	237	215	194	152	150	128	125	133	324	338	389	420	430	457	113	50					
483	484	475	470	425	411	391	356	335	316	294	273	231	229	207	204	212	403	417	468	499	509	536	192	129	79				

Willamette River

Snake River

C.P. 7

C.P. 7

DISTANCES IN STRAIT OF JUAN DE FUCA
AND STRAIT OF GEORGIA

CAPE FLATTERY, WASH., TO SEATTLE, WASH.,
AND VANCOUVER, CANADA

February 21, 1959

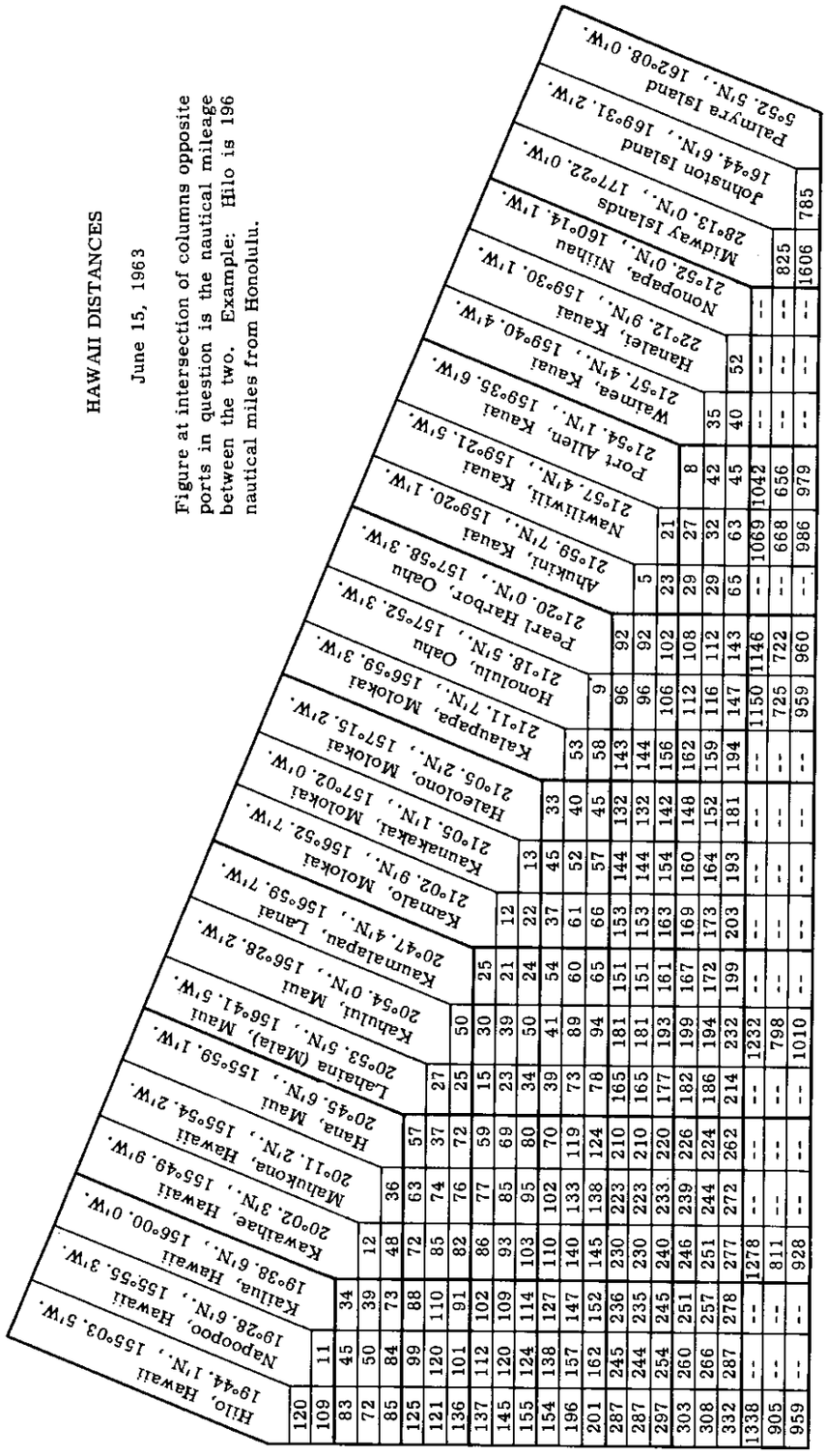
Figure at intersection of columns opposite ports in question is the nautical mileage between the two. Example: Port Angeles, Wash., is 69 nautical miles from Seattle, Wash.

CAPE FLATTERY, WASH. 48°26.0'N., 124°47.0'W.	SWIFTSURE BANK, WASH. 48°31.0'N., 125°00.0'W.	Neah Bay, Wash. 48°22.4'N., 124°36.5'W.	Port Angeles, Wash. 48°07.5'N., 123°26.4'W.	Victoria, Canada 48°25.0'N., 123°23.5'W.	Port Townsend, Wash. 48°06.8'N., 122°45.2'W.	Port Ludlow, Wash. 47°55.3'N., 122°41.0'W.	Port Gamble, Wash. 47°51.3'N., 122°34.7'W.	Everett, Wash. 47°59.3'N., 122°13.2'W.	Point Wells, Wash. 47°47.1'N., 122°23.7'W.	Seattle, Wash. 47°36.2'N., 122°20.3'W.	Eagle Harbor, Wash. 47°37.2'N., 122°30.7'W.	Bremerton, Wash. 47°33.5'N., 122°38.0'W.	Tacoma, Wash. 47°16.0'N., 122°26.0'W.	Olympia, Wash. 47°03.1'N., 122°54.3'W.	Roche Harbor, Wash. 48°36.6'N., 123°09.1'W.	Friday Harbor, Wash. 48°32.2'N., 123°00.9'W.	Anacortes, Wash. 48°31.4'N., 122°36.7'W.	Bellingham, Wash. 48°45.1'N., 122°29.0'W.	Blaine, Wash. 48°59.5'N., 122°45.9'W.	Nanaimo, Canada 49°10.1'N., 123°56.0'W.	New Westminster, Canada 49°12.0'N., 122°54.5'W.	Vancouver, Canada 49°17.4'N., 123°06.6'W.
10																						
10	20																					
61	71	54																				
62	71	55	19																			
86	96	79	32	34																		
100	110	93	46	48	16																	
104	114	97	50	53	21	10																
117	127	110	63	66	34	26	28															
111	121	103	56	59	27	19	21	16														
124	134	116	69	72	40	32	34	30	14													
123	133	115	68	71	40	32	34	29	14	8												
131	141	124	77	80	48	40	42	38	23	14	13											
143	153	136	89	91	59	52	53	49	34	25	25	29										
168	178	160	113	115	84	75	78	73	59	50	50	50	34									
83	92	76	36	25	41	54	58	71	64	77	76	85	96	121								
87	96	80	37	30	30	44	48	62	54	67	67	76	86	112	12							
93	102	86	42	36	30	43	47	49	54	66	66	74	86	110	27	18						
108	117	101	54	50	43	57	61	63	68	80	80	88	100	124	37	28	17					
112	121	105	65	55	59	72	76	80	83	95	95	104	115	139	35	37	36	38				
145	154	138	99	89	97	111	115	118	121	134	134	142	154	177	66	69	76	75	55			
139	148	132	93	82	91	105	109	114	116	128	128	137	148	171	60	60	70	71	48	48		
141	150	133	95	83	92	106	110	115	117	129	129	138	149	173	62	62	71	72	48	36	41	

HAWAII DISTANCES

June 15, 1963

Figure at intersection of columns opposite ports in question is the nautical mileage between the two. Example: Hilo is 196 nautical miles from Honolulu.



Radio Bearing Conversion Table

Table of corrections, in minutes

[DIFFERENCE OF LONGITUDE IN DEGREES]

Mid. L.	½°	1°	1½°	2°	2½°	3°	3½°	4°	4½°	5°	5½°	6°	6½°	7°	7½°	8°	8½°	9°	9½°	10°
15°	4	8	12	16	19	23	27	31	35	40	43	47	50	54	58	62	66	70	74	78
16°	4	8	12	17	21	25	29	33	37	41	45	50	54	58	62	66	70	74	79	83
17°	4	9	13	18	22	26	31	35	39	44	48	53	57	61	66	70	75	79	83	88
18°	5	9	13	19	23	28	32	37	42	46	51	56	60	65	70	74	79	83	88	93
19°	5	10	15	20	24	29	34	39	44	49	54	59	63	68	73	78	83	88	93	98
20°	5	10	15	21	26	31	36	41	46	51	56	62	67	72	77	82	87	92	98	103
21°	5	11	16	21	27	32	38	43	48	54	59	64	70	75	81	86	91	97	102	108
22°	6	11	17	22	28	34	39	45	51	56	62	67	73	79	84	90	96	101	107	112
23°	6	12	18	23	29	35	41	47	53	59	64	70	76	82	88	94	100	105	111	117
24°	6	12	18	24	31	37	43	49	55	61	67	73	79	85	92	98	104	110	116	122
25°	6	13	19	25	32	38	44	51	57	63	70	76	82	89	95	101	108	114	120	127
26°	7	13	20	26	33	39	46	53	59	66	72	79	85	92	99	105	112	118	125	131
27°	7	14	20	27	34	41	48	54	61	68	75	82	89	95	102	109	116	123	129	136
28°	7	14	21	28	35	42	49	56	63	70	77	84	92	99	106	113	120	127	134	141
29°	7	15	21	29	36	44	51	58	65	73	80	87	95	102	109	116	124	131	138	145
30°	7	15	22	30	38	45	53	60	68	75	83	90	98	105	113	120	127	135	143	150
31°	8	15	23	31	39	46	54	62	70	77	85	93	100	108	116	124	131	139	146	155
32°	8	16	24	32	40	48	56	64	72	79	87	95	103	111	119	127	135	143	151	159
33°	8	16	25	33	41	49	57	65	74	82	90	98	106	114	123	131	139	147	155	163
34°	8	17	25	34	42	50	59	67	75	84	92	101	109	117	126	134	143	151	159	168
35°	9	17	26	34	43	52	60	69	77	86	95	103	112	120	129	138	146	155	163	172
36°	9	18	26	35	44	53	62	71	79	88	97	106	115	123	132	141	150	159	168	176
37°	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135	144	153	163	172	181
38°	9	18	28	37	46	55	65	74	83	92	102	111	120	129	139	148	157	166	175	185
39°	9	19	28	38	47	57	66	75	85	94	104	113	123	132	142	151	160	170	179	189
40°	10	19	29	39	48	58	68	77	87	96	106	116	125	135	145	154	164	174	183	193
41°	10	20	30	39	49	59	69	79	89	98	108	118	128	138	148	157	167	177	187	197
42°	10	20	30	40	50	60	70	80	90	100	110	120	130	140	151	161	171	181	191	201
43°	10	20	31	41	51	61	72	82	92	102	113	123	133	143	153	164	174	184	194	205
44°	10	21	31	42	52	63	73	83	94	104	115	125	135	146	156	167	177	188	198	208
45°	11	21	32	42	53	64	74	85	95	106	117	127	138	149	159	170	180	191	201	212
46°	11	22	32	43	54	65	76	86	97	108	119	129	140	151	162	173	183	194	205	216
47°	11	22	33	44	55	66	77	88	99	110	121	132	143	154	165	176	186	197	208	219
48°	11	22	33	45	56	67	78	89	100	111	123	134	145	156	167	178	190	201	212	223
49°	11	23	34	45	57	68	79	91	102	113	125	136	147	158	170	181	192	204	215	226
50°	11	23	34	46	57	69	80	92	103	115	126	138	149	161	172	184	195	207	218	230
51°	12	23	35	47	58	70	82	93	105	117	128	140	152	163	175	186	198	210	221	233
52°	12	24	35	47	59	71	83	95	106	118	130	142	154	165	177	189	201	213	225	236
53°	12	24	36	48	60	72	84	96	108	120	132	144	156	168	180	192	204	216	228	240
54°	12	24	36	49	61	73	85	97	109	121	133	146	158	170	182	194	206	218	231	243
55°	12	25	37	49	61	74	86	98	111	123	135	147	160	172	184	197	209	221	233	246
56°	12	25	37	50	62	75	87	100	112	124	137	149	162	174	187	199	211	224	236	249
57°	13	25	38	50	63	75	88	101	113	126	138	151	164	176	189	201	214	226	239	252
58°	13	25	38	51	64	76	89	102	115	127	140	153	165	178	191	204	216	229	242	254
59°	13	26	39	51	64	77	90	103	116	129	141	154	167	180	193	206	219	231	244	257
60°	13	26	39	52	65	78	91	104	117	130	143	156	169	182	195	208	221	234	247	260

Example. A ship in latitude 39°51′. N., longitude 67°35′ W., by dead reckoning, obtains a radio bearing of 299° true on the radiobeacon located in latitude 40°37′. N., longitude 69°37′ W.

Radiobeacon station	Latitude	40°37′ N.
Dead-reckoning position of ship	Latitude	39°51′
Middle latitude		40°14′
Radiobeacon station	Longitude	69°37′ W.
Dead reckoning position of ship	Longitude	67°35′
Longitude difference		2°02′

Entering the table with difference of longitude equals 2°, which is the nearest tabulated value and opposite 40° middle latitude, the correction of 39′ is read.

As the ship is east of the radiobeacon, a minus correction is applied. The Mercator bearing then will be 299°−000°39′=298°21′. To facilitate plotting, subtract 180° and plot from the position of the radiobeacon the bearing 298°21′−180°, or 118°21′ (Mercator bearing reckoned clockwise from true north).

Distance of Visibility of Objects at Sea

The following table gives the approximate geographic range of visibility for an object which may be seen by an observer whose eye is at sea level; in practice, therefore, it is necessary to add to these a distance of visibility corresponding to the height of the observer's eye above sea level.

Height, feet	Nautical miles	Height, feet	Nautical miles	Height, feet	Nautical miles	Height, feet	Nautical miles	Height, feet	Nautical miles
6	2. 8	48	7. 9	220	17. 0	660	29. 4	2, 000	51. 2
8	3. 1	50	8. 1	240	17. 7	680	29. 9	2, 200	53. 8
10	3. 6	55	8. 5	260	18. 5	700	30. 3	2, 400	56. 2
12	4. 0	60	8. 9	280	19. 2	720	30. 7	2, 600	58. 5
14	4. 3	65	9. 2	300	19. 9	740	31. 1	2, 800	60. 6
15	4. 4	70	9. 6	320	20. 5	760	31. 6	3, 000	62. 8
16	4. 6	75	9. 9	340	21. 1	780	32. 0	3, 200	64. 9
18	4. 9	80	10. 3	360	21. 7	800	32. 4	3, 400	66. 9
20	5. 1	85	10. 6	380	22. 3	820	32. 8	3, 600	68. 6
22	5. 4	90	10. 9	400	22. 9	840	33. 2	3, 800	70. 7
24	5. 6	95	11. 2	420	23. 5	860	33. 6	4, 000	72. 5
26	5. 8	100	11. 5	440	24. 1	880	34. 0	4, 200	74. 3
28	6. 1	110	12. 0	460	24. 6	900	34. 4	4, 400	76. 1
30	6. 3	120	12. 6	480	25. 1	920	34. 7	4, 600	77. 7
32	6. 5	130	13. 1	500	25. 6	940	35. 2	4, 800	79. 4
34	6. 7	140	13. 6	520	26. 1	960	35. 5	5, 000	81. 0
36	6. 9	150	14. 1	540	26. 7	980	35. 9	6, 000	88. 8
38	7. 0	160	14. 5	560	27. 1	1, 000	36. 2	7, 000	96. 0
40	7. 2	170	14. 9	580	27. 6	1, 200	39. 6	8, 000	102. 6
42	7. 4	180	15. 4	600	28. 0	1, 400	42. 9	9, 000	108. 7
44	7. 6	190	15. 8	620	28. 6	1, 600	45. 8	10, 000	114. 6
46	7. 8	200	16. 2	640	29. 0	1, 800	48. 6		

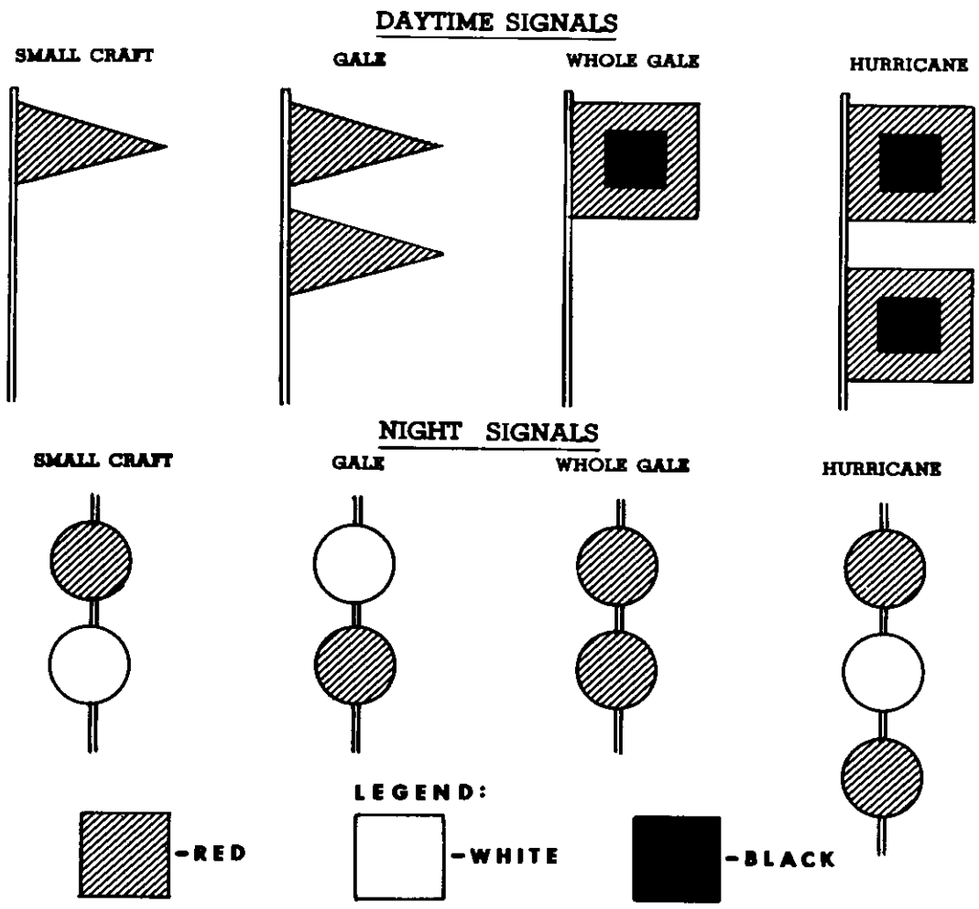
Conversion Table, Degrees to Points and Vice Versa

° ′	Points	° ′	Points	° ′	Points	°	Points
0 00	N	90 00	E	180 00	S	270 00	W
2 49		92 49		182 49		272 49	
5 38	N ½ E	95 38	E ½ S	185 38	S ½ W	275 38	W ½ N
8 26		98 26		188 26		278 26	
11 15	N x E	101 15	E x S	191 15	S x W	281 15	W x N
14 04		104 04		194 04		284 04	
16 53	N x E ½ E	106 53	ESE ½ E	196 53	S x W ½ W	286 53	WNW ½ W
19 41		109 41		199 41		289 41	
22 30	NNE	112 30	ESE	202 30	SSW	292 30	WNW
25 19		115 19		205 19		295 19	
28 08	NNE ½ E	118 08	SE x E ½ E	208 08	SSW ½ W	298 08	NW x W ½ W
30 56		120 56		210 56		300 56	
33 45	NE x N	123 45	SE x E	213 45	SW x S	303 45	NW x W
36 34		126 34		216 34		306 34	
39 23	NE ½ N	129 23	SE ½ E	219 23	SW ½ S	309 23	NW ½ W
42 11		132 11		222 11		312 11	
45 00	NE	135 00	SE	225 00	SW	315 00	NW
47 49		137 49		227 49		317 49	
50 38	NE ½ E	140 38	SE ½ S	230 38	SW ½ W	320 38	NW ½ N
53 26		143 26		233 26		323 26	
56 15	NE x E	146 15	SE x S	236 15	SW x W	326 15	NW x N
59 04		149 04		239 04		329 04	
61 53	NE x E ½ E	151 53	SSE ½ E	241 53	SW x W ½ W	331 53	NNW ½ W
64 41		154 41		244 41		334 41	
67 30	ENE	157 30	SSE	247 30	WSW	337 30	NNW
70 19		160 19		250 19		340 19	
73 08	ENE ½ E	163 08	S x E ½ E	253 08	WSW ½ W	343 08	N x W ½ W
75 56		165 56		255 56		345 56	
78 45	E x N	168 45	S x E	258 45	W x S	348 45	N x W
81 34		171 34		261 34		351 34	
84 23	E ½ N	174 23	S ½ E	264 23	W ½ S	354 23	N ½ W
87 11		177 11		267 11		357 11	

BEAUFORT SCALE OF WIND FORCE

Beaufort Number	Miles per Hour	Knots	Wind Effects Observed at Sea	Terms Used In U.S.W.B. Forecasts
0	Less than 1	Less than 1	Sea like a mirror	
1	1- 3	1- 3	Ripples with the appearance of scales formed, but without foam crests	Light
2	4- 7	4- 6	Small wavelets, short but pronounced; crests appear glassy, do not break	
3	8-12	7-10	Large wavelets with crests beginning to break; foam appears glassy. Perhaps scattered white horses (white foam crests).	Gentle
4	13-18	11-16	Small waves, becoming longer; fairly frequent white horses	Moderate
5	19-24	17-21	Moderate waves of a pronounced long form; many white horses, possibly some spray.	Fresh
6	25-31	22-27	Large waves begin to form; white foam crests more extensive everywhere; probably some spray.	Strong
7	32-38	28-33	Sea heaps up; some white foam from breaking waves blows in streaks along the direction of the wind.	
8	39-46	34-40	Moderately high waves. Edges of crests begin to break into spindrift. Well-marked streaks of foam blow along direction of wind.	Gale
9	47-54	41-47	High waves. Dense streaks of foam along direction of wind. Spray may affect visibility.	
10	55-63	48-55	Very high waves with long overhanging crests; great patches of foam blown in dense white streaks along direction of wind. Sea surface takes on a white appearance. Visibility affected.	Whole gale
11	64-72	56-63	Exceptionally high waves; sea completely covered with long white patches of foam lying along direction of wind; edges of wave crests everywhere blown into froth. Visibility affected.	
12 or more	73 or more	64 or more	Air filled with foam and spray; sea completely white with driving spray. Visibility very seriously affected.	Hurricane

SMALL CRAFT, GALE, WHOLE GALE AND HURRICANE WARNINGS



EXPLANATION OF DISPLAY SIGNALS

SMALL CRAFT WARNING: One red pennant displayed by day and a red light above a white light at night to indicate winds up to 33 knots and/or sea conditions dangerous to small craft operations are forecast for the area.

GALE WARNING: Two red pennants displayed by day and a white light above a red light at night to indicate winds ranging from 34 to 47 knots are forecast for the area.

WHOLE GALE WARNING: A single square red flag with a black center displayed during daytime and two red lights at night to indicate winds ranging from 48 to 63 knots are forecast for the area.

HURRICANE WARNING: Two square red flags with black centers displayed by day and a white light between two red lights at night to indicate that winds 64 knots and above are forecast for the area.