Weather.—The weather over Bering Sea is generally bad and very changeable. Good weather is the exception and it does not last long when it does occur. Wind shifts are both frequent and rapid. The late spring and summer seasons have much fog and considerable rain. In early fall the gales increase, the fogs lessen, and snow is likely any time after mid-September. Late fall and early winter is the time of almost continuous storminess. Heavy winds from any direction are usually accompanied by precipitation; however, the rain or snow which comes with easterly or southerly winds is likely to continue steadily until the wind shifts while rain or snow squalls are characteristic of the westerly and northerly winds. Skies tend to clear quicker with the slackening of the velocity if the winds have been blowing from northerly or westerly directions.

Taking the area as a whole, the winds are most frequently from northerly and northeasterly directions from October through May and are variable, with predominating winds from directions in the south half of the compass at most stations during the period from June through September. The local topography, however, influences the prevailing wind so that the general wind circulation does not show conditions at the individual stations. Winds are quite variable at St. Paul Island, even in winter, with an average velocity of 16 knots and a maximum reported since 1939 of 49 knots. In November 1932, a velocity of 99 knots was reported.

Over much of Bristol Bay the winds are from northeasterly directions from October to March, and most frequently from southwesterly directions during the late spring, summer, and early fall. The average wind velocity at Port Heiden is 15 knots. At Naknek, near the head of Bristol Bay, the prevailing winds are northerly except during the summer; the average velocity is about 10 knots.

At Bethel, the head of ocean navigation on Kuskokwim River, the winds are from the northerly directions most frequently from September through June, with southerly winds prevailing in July and southwesterly winds in August. The average wind velocity at Bethel is 12 knots. At Hooper Bay the prevailing winds are northeasterly from November through February and are quite variable during the other 8 months. The prevailing winds at Nome are northeasterly from September through May and are southwesterly in mid-summer. The average wind velocity at Nome is 10 knots, and a maximum velocity of 65 knots was reported in January 1950. At Gambell, on the northernmost point of St. Lawrence Island, the prevailing winds are southwesterly during the summer, but are generally northerly or northeasterly during the other seasons. Few Greenwich noon ship observations are available over this part of the Bering Sea for the winter and spring seasons. In mid-summer the ship observations indicate a general tendency to winds from southerly directions while in the fall the winds are shifting to the north. Gales of force 8 or higher appear to be rather unusual in summer over the waters of this area, but possibly 6 percent of the ship observations show such gales in the month of October.

Most of the precipitation over Bristol Bay and the Bering Sea is in July through September, with August the rainiest month at most stations. The total annual snowfall ranges from 30 inches at Hooper Bay to 60 inches at Nome; Naknek has a total of 43 inches.

The annual mean temperatures along the Bering coast range from 21° F. at Wales, on the north edge of the area, to 38° F. at Port Heiden. The highest temperature recorded in the area is 86° F. at Bethel in June while —55° F. is the record low value recorded at Golovin and at White Mountain in January and also at St. Michael in February. The Japan Current system does not moderate the winter temperatnres even over the southern edge of the Bering Sea to the extent that it moderates temperatures south of the Aleutians. Over the eastern half of the Bering Sea the average of the daily minimum temperatures is less than 32° for about 8 months of each year, and is lower than 0° F. for 1 or 2 months at most coastal stations of the area.

Fog occurs in every month of the year at most localities along the Bering coast; the maximum is in mid-summer and the minimum is in the fall. It is reported that summer fogs in the Bering Sea, while sometimes very dense, often extend less than 100 feet above the water. It is, therefore, often possible to make a landfall by sending a man aloft where he will be able to see over the fog. It is also often possible to make high islands and capes by working up to them from leeward and taking advantage of a rift in the fog that prevails to leeward of such features. This rift in the fog is called the **Ookah** by the natives; it does not exist in the lee of lowlands, small islands, or during a calm.

Thunderstorms occur over the eastern half of the Bering Sea. Such storms are rare, however, as no station records an average of more than one day per year on which a thunderstorm has occurred. They are most frequently observed in mid-summer.

There is much cloudiness over the Bering Sea with an average of from 60 to 80 percent of the sky covered the year around. There is usually, however, considerably more cloudiness in mid-summer than during the winter months.

Ice.—Except in sheltered places the ice of Bering Sea is in detached fields, floes, and cakes, which are continually kept in motion, breaking up, piling, and telescoping by the action of variable winds and currents. At no time is the sea one solid sheet of ice, and in the winter, when it is forming, the ice is more scattered than in the spring, when the northerly movement begins and packs it closer together. The general southern limit of ice is from Bristol Bay to the vicinity of St. George Island, and thence about west-northwest to the Siberian shore. The southern edge is ragged and very much scattered, and continued northerly winds sometimes drive fields of it far southward. As a rule, no heavy ice will be encountered south of the Pribilof Islands and the ice in their vicinity is likely to be nothing more than detached fields.

In the spring, beginning with April, there is a general northward movement of the ice, the shore clearing ahead of the center of the sea; but the ice sometimes hangs on in

the bays and around the islands later than in the open sea. The movement and position of the ice depend greatly on the winds. Generally, by June 1, the whole body of ice is well up with St. Lawrence Island, and a passage opens to its west side. The eastern side of the sea is likely to be obstructed a little later than the western side, and ice is often met between St. Lawrence Island and Nunivak Island in the early part of June. The breaking out of the rivers in the latter part of May clears the shores, but the ice is likely to hold in Norton Sound several weeks later. In general, for a vessel not fitted to encounter ice, Norton Sound is not navigable before the middle of June. At the opening of navigation the ice is likely to be heaviest and to remain longest on the north shore of Norton Sound and in general it is the latter part of June before that portion of the sound is altogether clear.

In the fall, young ice begins to form on the rivers, and in the bays and sheltered places, in October and grows stronger and spreads according to the severity of the advancing season. At Nome, on the north side of Norton Sound, navigation is difficult from early December to early June and is usually suspended from late December to mid-May.

Chart 8802.—Bristol Bay may be said to include all that part of Bering Sea lying east of a line drawn from Cape Sarichef, Unimak Island, to the Kuskokwim River. Unimak Island and the Alaska Peninsula bound it on the south and east, and separate it from the Pacific Ocean. The Naknek River is at the head of deep-water navigation, while the bay itself terminates in the Kvichak River a few miles northward. The region about Nushagak River, Kulukak Bay, and the Kuskokwim forms its northwest boundary.

The shores are generally low and nondistinctive, but high mountain ranges and volcanic cones extend along the central parts of Unimak Island and the Alaska Peninsula. These rugged snow-covered mountains and lofty peaks would serve as unmistakable landmarks were they not obscured by the almost constant fogs which prevail during the summer. The shore and objects near sea level are often seen beneath the fog when the higher lands are obscured and, therefore, most of the available landmarks are found on or near the beach.

The Bristol Bay region must be regarded as a dangerous locality to navigate; it is only by the greatest vigilance and constant sounding that disaster can be avoided upon approaching the land. This is particularly true of the northeast arms and approaches which receive the waters of the great salmon streams on which the Bering Sea canneries are located. The rivers discharge a great quantity of water into wide indentations which open on the arms of the great bay. The banks of the rivers are frequently marshy and generally muddy. The discolored water of the rivers is charged with a large amount of sediment, which, when deposited forms shoal areas.

The funnel-shaped configuration of the bay and river entrances creates tidal currents of great force, reaching, at times, velocities up to 6 knots. The diurnal range of tide averages about 18 feet at the river entrances. Vast areas of shoals uncover at low water, leaving only pools and narrow channels between them.

In Bristol Bay and its tributaries, lights and buoys are maintained by the Alaska Department of Fish and Game during the fishing season from June 5 to August 15 to mark fishing districts; they usually show quick flashing white lights. Marine lights and buoys are normally maintained only during the navigation season from May 1 to September 30; buoys in Kuskokwim Bay and River are maintained from June 15 to September 30.

Vessels operating in Bristol Bay, particularly at the head, are warned concerning the use of sea water as a cooling agent in internal combustion engines, heat exchangers, condensers, and evaporators. The heavy amount of silt in suspension in this area can do great damage to the machinery or equipment if overlooked. This is especially true of small diesel or gasoline engines with gear-type water pumps, since the fine sand will pack itself between the gears and cause them to bind. Also, the silt is likely to settle in various parts of the cooling system and accordingly the system may need regular flushing. Most small-boat operators in the salmon fishing areas, such as Kvichak and Nushagak Bays, use freshwater cooling systems with piping led outboard.

Reports of ice conditions at the head of Bristol Bay usualy can be obtained from the King Salmon Alaska Communication System station near Naknek or the nearby canneries. On May 17, 1948, the survey ship PATHFINDER encountered floe ice about 20 miles northwest of Port Heiden and a solid field of drift ice about 10 miles west of Egegik Bay. At this time of the year, the run from off Port Moller to the head of Bristol Bay should be made during daylight because of possible ice. In 1948, several commercial vessels encountered difficulties attempting the run at night.

A **danger zone** of an air-to-air weapon range is in the northern part of Bristol Bay; limits and regulations are given in **204.222a,** chapter 2.

Chart 8860.—Cape Sarichef, described in chapter 7, the western end of the south coast of Bristol Bay, is low, with detached rocks close inshore, around which strong tidal currents sweep. The land falls away eastward in a gentle curve forming **Dublin Bay,** about 3 miles in depth and 16 miles across between the cape and Cave Point. This bay may be used as a temporary anchorage by vessels of any size. The holding ground is said to be good. From offshore the first 8 miles of this indentation present themselves as a smooth grassy slope gradually rising from low, rocky, grass-covered bluffs, about 60 to 100 feet high, to the mountains several miles inland.

The beach is steep and the surf breaks almost at the shoreline. The terrain leading back is quite rugged and is cut by numerous gullies. Along this part of the coast there are several prominent hills ranging from 800 to 2,000 feet high at distances of 2 to 4 miles back from the shore. **Red Hill,** although only 798 feet high, is a very distinctive formation near Cape Sarichef; it is isolated and closer to the shore than the other peaks in the vicinity. The hill is easily recognized by its reddish hue

and is prominent from the north, northeast, and west. It is often clear when higher peaks are obscured by fog or clouds.

A large valley, appearing not as a pass but as an indentation into the hills, is easily recognized from offshore. **Beartrack Creek,** having a considerable drainage area, is a swift stream flowing through a bed strewn with small boulders. About 6 miles northeast of Cape Sarichef are several waterfalls that may serve as landmarks for vessels close inshore.

The coast in the northern half of this moderate indentation is a series of low sand dunes, and the shore is sandy. From the line of dunes along the beach a large marshy area extends back for 2 or 3 miles, where a low pass begins and leads between the peaks to the south side of Unimak Island. Two moderate-sized streams and a number of small ones empty into the Bering Sea.

Southwest of Cave Point the bottom is generally even, of fine black sand, and good holding ground; the 10-fathom curve is from 0.4 to 0.8 mile from the beach. There are no charted shoals of any consequence, although the 10-fathom curve is a little farther off the points than off the bights and coves. The best anchorage is in about 10 fathoms, 7.5 miles 048° from Cape Sarichef Light. This anchorage affords protection from the northeast through the southeast, and around to the southwest. In northerly and northwesterly weather the current may prevent a vessel at anchor from heading into the sea.

Cave Point is a vertical rocky cliff formed by a ridge extending from the north side of Black Hill. It is named for a cave on its face inhabited by sea birds which in summer hover about it in thousands, making it conspicuous in clear weather by their numbers and in fog by their constant cries.

The point is very prominent and can be easily seen in clear weather from Cape Sarichef or from Cape Mordvinof. The water off Cave Point is deep; no shoals have been found. The 20-fathom curve runs about 1 mile off the point.

Black Hill, a black-looking hill about 3 miles east-southeast from Cave Point, is the highest peak near the shore; it can be plainly seen from the west to the north. The hill is covered with snow in the winter but is bare in the summer.

Between Cave Point and Oksenof Point, the most westerly point of Cape Mordvinof, is another moderate indentation in the coastline about 6.5 miles by 0.8 mile in size. The shore for 4 miles northeastward of Cave Point is a sandy beach with a series of grass-covered dunes just back of the high-water line. From the line of dunes a large flat area extends back for several miles; in this area is a large pond which is about 0.5 mile northeastward of Cave Point. Between this pond and the hills comprising Cape Mordvinof is a large swamp. One large stream empties into the sea at the north end of the sand beach. Offshore the bottom is even and no shoals of any importance have been found. The 20-fathom curve runs from 1 to 1.5 miles off the beach. The indentation in the coastline between Cave Point and Cape Mordvinof is a fair anchorage, giving some protection from the northeast around to the south. In northerly and northwesterly weather, currents affect the heading of an anchored vessel.

Snow-clad **Pogromni Volcano,** 8.3 miles eastward of Cape Sarichef Light, forms a striking background to the low, monotonous coast. The top of the 4,040-foot peak, 1.9 miles northward of Pogromni Volcano, is a ridge with no definite point. It is covered with snow most of the year and usually capped by clouds. However, at times, it is clear when Pogromni Volcano is not. On the northwestern slope of the volcano is a prominent arrowhead-shaped peak about 1,300 feet high. It is very prominent on the skyline from the north and northeast but is covered by clouds a great part of the time.

Cape Mordvinof consists of a succession of points and coves at the end of a series of round-topped ridges separated by shallow valleys. The point, including **Oksenof Point,** is characterized by precipitous rocky bluffs ranging from 450 feet high on the western side of the cape down to 100 feet on the east end. Small clear streams run through the valleys and the terrain slopes upward from the bluff line to a group of rocky peaks about 2,000 feet high. These peaks are snow covered in the winter and bare in the summer. The valleys and ridges are covered with grass and tundra. Good landmarks are lacking on Cape Mordvinof; the peaks are not distinctive and usually are hidden by clouds.

Good anchorage for large vessels is not found off the cape, but shelter from southerly winds can be had in two of the coves indenting the cape for boats no longer than 65 feet. The water deepens rapidly and evenly off the cape, and the 20-fathom curve is from 1 to 2 miles off the shoreline. No shoal of importance is known off the cape, and no danger to navigation has been found at distances greater than 1 mile offshore.

By making good a course of **036°** from 3 miles due west of Cape Sarichef for 25 miles, vessels will be well outside the 20-fathom curve and the known dangers to navigation.

Eastward of Cape Mordvinof, the coast falls away slightly for 6 miles, where it turns abruptly eastward for 5 miles, and then takes a northerly direction forming **Urilia Bay.** This bay is open northward, but affords protection from all winds from southward of east or west. The approaches are clear, and the water shoals gradually to 6 fathoms, black sand bottom, about 0.8 mile from shore.

From Urilia Bay to Isanotski Strait the coast trends northeasterly, is very low, and has several rocky patches extending 0.5 to 1 mile from shore. Shishaldin Volcano, near the middle of Unimak Island, is described in chapter 7.

Swanson Lagoon is a shallow lagoon on the north side of Unimak Island 7 miles westward from **Chunak Point.** It has a narrow entrance and during some years light-draft launches can enter, but at other times only pulling boats can. Inside it is mostly a mudflat at low water with crooked channels 1 to 3 feet deep flowing between tidal flats. The lakes draining into the lagoon are spawning places for salmon, and the lagoon is important only as a fishery. About 0.8 mile eastward of the entrance is a cone-shaped hill 85 feet high.

Isanotski Strait (False Pass), used only by small vessels, is described in chapter 6.

For 20 miles northeastward of Isanotski Strait to 175-foot high **Cape Glazenap,** the coast is low with some grassy 50 to 100-foot bluffs. Except off the entrance to Isanotski Strait, dangers are within a mile of the shore. Cape Glazenap is prominent because it is higher than the other places in this area.

The **Kudiakof Islands,** low, narrow, and grass covered, extend from Cape Glazenap to Moffet Point, 16 miles to the northeast. The wreck of an old schooner is a conspicuous landmark on the southwesterly island. The lights on the Cold Bay radio towers are visible over this general area on clear nights.

Behind Cape Glazenap and the Kudiakof Islands is **Izembek Lagoon** which is crossed by many shallow sloughs. Most of the extensive lagoon area is bare or awash; the bottom is mud and sand. The sloughs are difficult to follow except at low stages of the tide and are not recommended for craft drawing more than 3 or 4 feet.

The Cape Glazenap channel into Izembek Lagoon is narrow and shifting. The entrance is close to the cape and is between breakers that extend seaward about a mile. The entrance channel has a depth of about 6 feet. During the summer, fishermen mark the approach with a drum buoy.

Charts 8860, 8802.—Moffet Point, 95 miles northeastward of Cape Sarichef, is a curving sandy hook with dunes 40 to 60 feet high. A channel leads into the northeastern part of Izembek Lagoon between Moffet Point and the northeasterly part of the Kudiakof Islands. The depth over the bar is about 2 fathoms. The channel is between breakers, and during the summer is marked by drum buoys placed by local fishermen. Passage should not be attempted without local knowledge or by boats drawing more than 3 or 4 feet.

Moffet Lagoon, behind Moffet Point, is a shallow area similar to Izembek Lagoon but much smaller in extent. The two lagoons are joined south of Moffet Point. **Joshua Green River** empties into the east side of Moffet Lagoon.

Amak Island, 10 miles north-northwest of Cape Glazenap, is of volcanic origin. Along the shores are bluffs and huge boulders except on the south side, where there is a small flat that was the site of a World War II airstrip.

The foul ground off the north side of Amak Island includes rocks and reefs and prominent Sea Lion Rock, which is 2.5 miles to the northwest. A reef, which uncovers, is off the southeast side of the island and extends eastward 0.3 mile. A fair anchorage, affording protection from southwesterly to northwesterly winds, is about 0.5 mile east of the island, a mile northeast of the rocky ledge off the southeasterly point, in 8½ fathoms, gravel bottom.

The passage between Amak Island and the Kudiakof Islands is clear and is the usual track for small vessels. Depths in midpassage are 10 fathoms or more; currents are about 2 knots.

Sea Lion Rock is 94 feet high, and its southern slope is a rookery for sea lions. **Sea Lion Rock Light (55°28′ N., 163°12′ W.),** 94 feet above the water, is shown seasonally from a small white house on top of the rock.

From Moffet Point the low coast trends almost 70 miles east-northeastward to Cape Rozhnof, on the western side of Port Moller. A strong inshore set is frequently noted in this area.

Black Hill, 24 miles northeastward of Moffet Point and 3 miles inland, is prominent. About 16 miles to the eastward of Black Hill and 2 miles inshore is a low prominent sandhill known locally as **Last Knoll,** as it is the last knoll on the coast to be seen by a vessel bound eastward. Local vessels use this hill extensively in checking their distance to Port Moller.

Chart 8833.—Herendeen Bay and **Port Moller,** 175 miles northeastward of Cape Sarichef, are mostly shallow but deep channels lead almost to their heads. The common approach to both bays is over a very flat gently sloping bottom with low shores. Farther in there are extensive sand and gravel flats between deep channels. The earth bluffs along the beaches have hills behind them that increase in height to the southward. Herendeen Bay has deep water near its head and the mountains are broken by several large valleys, while the head of Port Moller is surrounded by high steep mountains, but deep water is restricted to narrow channels which apparently are kept open by tidal currents.

A stranger approaching Port Moller should radio the cannery at Entrance Point and request a pilot. Seasonal buoys maintained by the cannery should not be depended upon.

Kudobin Islands, on the west side of the entrance to Port Moller between **Lagoon Point** and **Cape Rozhnof,** are low and difficult to identify. The only distinctive feature is a 20-foot knob on the eastern end of **Walrus Island,** the easternmost island of the group.

Entrance Point, on the east side of the entrance to Port Moller, is low. A cannery is inside the point at the village of **Port Moller.**

Harbor Point, 4.5 miles south of Entrance Point, is a low, narrow, grassy, sand and shingle sandspit with high land behind it. Doe Point and Point Divide at the entrance to Herendeen Bay are bluffs which can be seen outside of Entrance Point.

Extensive shoals just inside Port Moller are subject to frequent change. A seasonal buoy marks the entrance channel. Anchorage can be had 3 miles westward of Entrance Point in 8 fathoms, fair to good holding ground. Discoloration of the water in this area is caused by streaks of sediment carried by the tidal currents. Tide rips are caused by sand waves rising above the general depths.

The current velocity at Port Moller is 1.5 to 2 knots; see the Tidal Current Tables. The diurnal range of tide is 10.8 feet.

The cannery wharf inside Entrance Point is 245 feet long and 145 feet along the face; depth alongside is about 25 feet. It is exposed to southerly and southeasterly winds which blow across the peninsula and through the

divides. Winds appear stronger at Entrance Point than at the anchorage in the middle of the bay entrance.

It is advisable to be ready to move on short notice if moored at the wharf as southeasterly winds come up very quickly, making it difficult to get away with the limited turning room. Many fishing vessels lay starboard side to the wharf in order to leave quickly. Larger supply vessels anchor in about 7 fathoms a mile south of the cannery.

Fishing boats and barges find protection from the southerly and southeasterly storms on the northwestern side of Harbor Point, 2.5 miles southward of Entrance Point.

Fresh water is available at the wharf at Entrance Point; gasoline, fuel oil, and diesel oil are stored for cannery use. A marine railway is maintained for cannery small boats. Limited provisions can be obtained at a store. Air transportation is reported to be available. Radiotelephone and radiotelegraph communications are maintained with the Alaska Communication System.

Point Divide, 9.5 miles southwestward of Entrance Point, has a 40-foot bluff with the land sloping gradually upward toward the mountain ranges. **Doe Point,** the southeastern end of **Deer Island** opposite Point Divide, is 50 feet high. The bluff on the east side of Deer Island is 150 feet high while the rest of the island and the mainland to the south and west are generally lower.

Hague Channel, leading to Herendeen Bay, is a mile wide at the northerly entrance but contracts to 700 yards between Point Divide and Doe Point. Tidal currents are very strong in the channel; as much as 4 knots on the spring flood. The current does not follow the axis of the channel but sweeps across the flats and narrow channel. As a result the channel is subject to change.

A survey vessel anchored 3 miles northeastward of Point Divide in 10 fathoms, sand and gravel bottom, and 2.8 miles west-southwestward of Point Divide in 8 fathoms, mud bottom; holding ground was good in both places.

On the flood tide, the current causes spectacular tide rips between Point Divide and Doe Point, with an extensive area of swirls farther inside Herendeen Bay. Small craft should use caution during flood tide, especially when the wind is against the current.

Johnston Channel, on the east side of Herendeen Bay, is 6 to 15 fathoms deep and very narrow with steep sides. **Halftide Rock,** on the east side of the channel 3 miles south of Point Divide, is awash at half tide. The current velocity is about 1.5 knots near the rock. **Eagle Rock,** near the easterly shore 3.8 miles southward of Point Divide, is pyramid shaped and prominent.

Small craft can find protection on either side of **Shingle Point,** in the small cove between Shingle Point and **Bluff Point,** and in **Mine Harbor.** Larger vessels can anchor off **Marble Point.**

Crow Reef, off the entrance to Mine Harbor, bares at low water and is an outlying danger in the upper bay. **Midway Reef,** extending 0.4 mile from the eastern shore of Mine Harbor, shows at half tide. A reef extends 0.5 mile westward from **Crow Point.**

A trail leads from the head of Herendeen Bay to Balboa Bay on the Pacific side of the Alaska Peninsula.

Chart 8802.—The coast is low between Port Moller and **Cape Kutuzof,** 20 miles to the north-northeastward. The cape rises in a rounded bluff to 150 feet.

Cape Seniavin Light (56°24′ N., 160°09′ W.), 175 feet above the water, is shown from a small white house on rocky **Cape Seniavin.** Except for a cluster of small hillocks about 12 miles from the cape, low beach extends from Cape Seniavin to Seal Islands.

Seal Islands, 30 miles northeastward of Cape Seniavin, are several barrier islets, barely above high water, strung along the coast for about 10 miles. It is reported that small boats can find protection behind the islands. The coast continues low from Seal Islands to Port Heiden.

Chart 8834.—Port Heiden, 250 miles northeastward of Cape Sarichef, is 9 miles in greatest width and extends inland about the same distance. The seaward side of the bay is formed by barrier sand bars 5 to 10 feet above high water. **Strogonof Point** is the northeast end of the barrier beach that extends from the southwest. Farther to the northeastward is crescent-shaped **Chistiakof Island,** which extends nearly to the mainland on the northeast side of the bay.

The approach to Port Heiden should be recognized by the high, bold headlands and the airfield installations on the northern side, but the bight back of Seal Islands, 20 miles to the southwest, has been mistaken for the bay. **Aniakchak Crater** is about 15 miles eastward of Port Heiden, and **Black Peak** is about the same distance to the southward.

On the mainland back of Chistiakof Island is the village of **Meshik.** A commercial airfield, numerous radio towers, and several prominent buildings lie about 4 miles north of the village.

The seaward approach has a uniformly gentle sloping bottom, with shoals extending considerably offshore. The 10-fathom curve is 6 to 8 miles off the bay, and the 20-fathom curve about 15 to 20 miles off. Over this area there is good holding bottom of fine sand and gravel, with some offshore sand waves lying perpendicular to the beach. Inshore of the 5-fathom curve the bottom tends to shoal abruptly.

No passage is recommended between Strogonof Point and Chistiakof Island because of numerous shifting bars. Small boats, however, can approach Meshik around the northeast end of Chistiakof Island, with local knowledge and by exercising caution.

The bottom in Port Heiden is sand and mud, and the holding properties are considered poor. The landing area off the cannery at Meshik is long and sloping, and heavy loading should be done in the latter stages of a rising tide because of the flats that uncover at low water.

The diurnal range of tide in Port Heiden is 12.1 feet. The current velocity is 1 knot; the ebb current seems to be increased by a southeast wind. Sea ice conditions are variable, with navigation seldom entirely suspended;

drift ice usually restricts navigation to full-powered vessels from January through April.

Chart 8802.—From Port Heiden the same low coast extends in nearly a direct line to **Cape Menshikof,** where the high land of Port Heiden gradually recedes from the coast. Cape Menshikof is a high bluff, extending some distance alongshore, with hilly country back of it.

Cinder River, 20 miles southwestward from Ugashik River, is a shallow indentation in the coastline that is often mistaken for the Ugashik.

Ugashik River empties into the wide indentation between Cape Menshikof and Cape Greig, a distance of 15 miles. The capes can be approached from westward to within about 2 miles. The coast between the capes, including the river valley, appears low. **Smoky Point Light (57°38′ N., 157°42′ W.),** 45 feet above the water, is shown from a small white house on a white skeleton tower on **Smoky Point,** a bluff on the north side of the entrance, 7 miles southward of Cape Greig. Here the river is about 4 miles wide at high water. The indentations between the capes, including the mouth of the river, are filled with shoals. A channel with about 10 feet is buoyed during the season for the use of the cannery vessels, but a stranger could not follow it with safety. Only launches can approach the cannery at low water because of boulders in the channel. The river is fresh at low water about 5 miles above Ugashik.

A lighted bell buoy marks the entrance to Ugashik River. Each year the cannery company anchors two floats on the north side of the channel at the entrance.

A cannery is near the entrance at **Pilot Point** (1960 population 61; P.O.). The wharf is 144 feet long but dries at low water. Fresh water is available on the wharf. Gasoline, fuel, and diesel oils are stored for cannery use. A machine shop and scowway are maintained by the cannery; a 4-ton crane is on the wharf. Radiotelegraph communication is maintained with the Alaska Communication System.

A cannery at the village of **Ugashik** (1960 population 86; P.O.), 13 miles from the entrance, has a wharf 200 feet in length with a depth of 14 feet at high water but is reported dry at half tide. Fresh water is available on the wharf and by barge at the anchorage. Gasoline and diesel oil are stored for cannery use and there is a 2-ton crane on the wharf. The cannery has a machine shop and a scowway. Small tenders are beached for light hull repairs.

Cape Greig is a prominent brownish bluff, with a few yellow vertical stripes extending several miles alongshore. It appears to be the seaward end of a low ridge with low land on each side. This and a peculiar notched mountain some distance inland are good marks. **Cape Greig Light (57°44′ N., 157°42′ W.),** 350 feet above the water, is shown from a white house.

Cape Greig is probably the best landfall for the approach to Kvichak and Nushagak Bays from southwestward. North of Cape Greig, the coast is low and has no distinguishing features, and even radar is not of much assistance until abeam of Egegik Bay. Particular care should be taken to clear the shoals off the entrance to this bay. After passing the bay, Middle Bluff can usually be identified, although the lights on this bluff and on Red Bluff are small structures not easily seen from offshore. **Johnston Hill,** 357 feet high, is not readily identified by a stranger approaching from the southwest, but abeam of the hill and thence to the northeastward a sharp tip on the northern side is very prominent.

Chart 9051.—Kvichak Bay, the large arm at the head of Bristol Bay, extends northeastward from a line between the south entrance point of Egegik River and Etolin Point. The bay is an important fishing area for red salmon and there are several canneries in its northern part. Kvichak Bay is navigable for deep-draft vessels as far as the anchorage about due west of the entrance to the Naknek River. The approach from the southwest is restricted to a channel about 3 miles wide by **Big Flat,** an extensive tide flat extending off the east shore, and by **Dead Man Sands,** the large shoal in the middle of the bay northwest of Johnston Hill. This shoal uncovers about 8 feet and the area north of it is very foul. Fishing boats and collecting barges use the area at half tide or higher. Caution is necessary as a number of fishermen have been lost when trapped by the tides.

About midway between Middle Bluff Light and Johnston Hill are two low spits which, while not discernible visually from a vessel in midchannel, are quite prominent on a radarscope and hence are valuable landmarks during periods of low visibility.

North of Naknek River are numerous shoals and uncovered banks. The best water is on the east side of the bay between Naknek River and Koggiung, but local knowledge is needed to avoid the shoals. The land is low and flat but the tanks and buildings of the canneries and the lights, which are maintained during the canning season, are good landmarks.

Kvichak River, which empties into the head of Kvichak Bay, is the outlet for Lakes Iliamna and Clark, on the western side of the mountain system that borders Cook Inlet. At maximum ebb, the confluence of discharges from Naknek and Kvichak Rivers is apt to cause overfalls which are dangerous to small boats. Winds in excess of 20 knots, opposed to currents, make the bay quite rough for vessels of light draft.

Good holding ground is available any place in Kvichak Bay where depths are suitable for anchorage. The bottom appears to consist of a layer of coarse gravel, sand, and stones, with mud beneath. The shoal depths permit a generous scope of chain which is necessary because of the strong currents and frequent blows. Only one anchor is recommended because of the tendency of a vessel to swing to the direction of the current, despite wind direction, with consequent fouling if moored with two anchors. Experience has shown that a scope of 8 or 10 to 1 will withstand the effects of a 60-knot wind and a 3.5-knot current. With a strong wind opposed to current, a vessel will usually lie broadside to both, and while such a condition sometimes causes an anchor to walk, no such tendency has been experienced in this area.

Tides.—The diurnal range of the tide at the Naknek River entrance is 22.6 feet. Daily tide predictions for Nushagak Bay are given in the Tide Tables. Tidal differences and constants for a number of stations in the Kvichak Bay area are listed in the Tide Tables.

Navigators are reminded that the great range of tide in this bay must be considered when selecting an anchorage.

Currents.—In Kvichak Bay and River the current is very strong, and consequently the channel shifts more or less each year. The current velocity is 3.5 knots in the lower part of the bay and 2.5 knots in the main ship anchorage off Naknek. In Naknek River at the **hole** off Morakas Point, 4 miles above the entrance, the current velocities are about 1 knot on the flood and 2 knots on the ebb. See the Tidal Current Tables for predictions.

It is recommended that vessels anchor against the current, when it is at maximum strength, so that engines may be used to offset the sudden strain when the anchor is let go. Caution must also be exercised, on flood current, to keep the vessel from being carried beyond the anchorage area while maneuvering. Since the currents usually follow the axes of the bay channels, navigators should make ample allowance when proceeding between Kvichak and Nushagak Bays; otherwise they are apt to be set to the north or to the south when they are on an easterly or westerly course.

Weather and ice.—The best weather in Kvichak and Nushagak Bays appears to be from the latter part of May through July. The bays are frozen over during the winter and the ice usually does not break up until May. Vessels approaching the bays during this time of the year, which they frequently do in preparation for the fishing season, are cautioned to do so during daylight hours because of possible ice.

Storms have a tendency to move into this area from the Aleutian Islands during August and September and, while their intensity usually is diminished, their rate of movement is decreased and at times they remain stationary while the depressions fill, thus causing extended periods of poor weather. Fog is not as prevalent in these bays as farther to the southwestward in Bristol Bay proper. Storms south of the Alaska Peninsula at times cause strong winds to draw through the valleys, such as that of the Egegik River, thus giving the effect of williwaws near the valley entrances.

Ice begins to form in November but the salmon pack usually is shipped out in August and most canneries go on a caretaker status in September, with all floating equipment hauled out on ways. Winter activities in the area consist mostly of hunting and trapping, with transportation by skiplanes and dogsleds. During the ice-free months practically all transportation is by water or air, since there are virtually no roads.

Mirages are seen frequently in the Kvichak Bay area during periods of calm, and particularly at low tide. They distort the appearance of bluffs and shorelines and make tanks and other elevated structures visible at greater distances than their altitudes warrant.

Pilotage.—Practically all of the canneries in this region are equipped with radio communication, and strangers should arrange for a pilot in that manner. The captains of the local cannery tenders are all familiar with local waters, and no trouble is experienced in getting a competent pilot.

Egegik River empties into Kvichak Bay 30 miles north of Cape Greig; **Cape Chichagof** is the northern entrance point. It is a large river, 1 mile wide at the canneries, and is the outlet of **Becharof Lake.** It flows in a westerly direction for more than 28 miles.

The lower part of the river forms **Egegik Bay.** At low water a large part of its area is bare. At the entrance, shoal water extends 6 miles offshore and should be given a wide berth by passing vessels. Entering vessels, depending upon their draft and condition of the sea, generally cross the entrance bar between half and full tide stages only.

A lighted bell buoy is 2.5 miles off the entrance bar. Moderately heavy seas will break over this bar with any stage of tide although it has 4 fathoms over it at high water. It is considered the most dangerous bar in the Bristol Bay area.

Red Bluff Light (58°14′ N., 157°29′ W.), 96 feet above the water, is shown from a small white house on prominent **Red Bluff.** The structure is difficult to see in the daytime.

There are two partially protected anchorages with limited swinging room at the entrance to Egegik River that are used by power scows and large tugs. The principal one is the channel inside **Coffee Point,** with depths up to 5 fathoms. A smaller anchorage lies just east of the dock at Egegik, with 4 fathoms at high water. Ebb current at the smaller anchorage is very strong.

Egegik River is navigable to small boats for its entire length into and across Becharof Lake. Although tidal to the foot of the rapids, mean range in its lagoons is only 1 foot; 5- to 6-foot drafts can be carried through the river, but the small lagoon reduces this to 3 or 4 feet, depending upon water stage. The controlling depth of the ¼-mile rapids of the lake outlet is 4 feet at low water stage. Although its midchannel current averages 5 knots, slow-speed powerboats run it frequently with and without handline aid from the shore. The river is open from May to October.

Freight from oceangoing vessels is generally lightered into Egegik from the ship anchorage off Naknek. **Egegik** (1960 population 150; P.O.) has limited facilities; a cannery wharf which is 80 feet long dries at low water. Fresh water and a 5-ton crane are available. Boat gasoline and diesel fuel are available for local use only. Another cannery wharf, located across the river, is 150 feet long with less water at its face. This cannery is inoperative, but its marine railway is active and hauls out barges, drivers, and tugs for winter layup. Two stores remain open for the year in Egegik. Their supplies are principally food staples and clothing.

See appendix for dates of ice breakup and freezeup.

Radiotelegraph communications are maintained with the Alaska Communication System. Transportation is

available by itinerant floatplane from May to October, and is usually obtained from Naknek village or King Salmon Airport.

Middle Bluff Light (58°24′ N., 157°32′ W.), 105 feet above the water, is shown from a small white house on **Middle Bluff**; the structure is difficult to see in the daytime.

Naknek River enters Kvichak Bay on the eastern side, about 15 miles southward of Koggiung. **Cape Suworof** is the point on the north side of the entrance. The large 60-mile-long river has its source in **Lake Naknek,** on which two villages are located.

Anchorage can be had off the entrance to Naknek River in 35 to 40 feet; this is the head of navigation for deep-draft vessels. The approach channel to this anchorage has depths of 33 to 60 feet.

The extreme range of **tide** at the river mouth is more than 25 feet. Tidal data for the river is given in the Tide Tables.

Shoals and banks, many of which uncover, fill the lower course of the river and extend 3 or 4 miles, then trend around northward and join the body of the banks that fill the upper end of Kvichak Bay. With local knowledge, craft drawing 4 feet can enter the river at low water and proceed as far as the Diamond NN Cannery.

Naknek Light (58°42′ N., 152°05′ W.), 78 feet above the water, is shown from a small white house on the south side of the entrance. **Naknek Entrance Light (58°43′ N., 157°03′ W.)**, 104 feet above the water, is shown from a small white house on the north side.

There are several large salmon canneries along Naknek River, and all have wharves that bare alongside at low water. Some of the canneries have not operated for years. Deep-draft vessels anchor about 6 miles off the entrance to the river and lighter their freight ashore in barges which are available at Naknek; the approaches to the anchorages vary little from year to year. Vessels drawing up to 10 feet can go alongside the cannery wharves at half tide but can remain afloat at low water only by shifting to what is called the **hole** just eastward of **Morakas Point,** which is 4 miles above the river mouth. The hole has depths of 9 to 14 feet at low water over a narrow crooked area 200 to 300 feet wide and about 0.5 mile long. Mooring buoys are maintained in this hole by the canneries from May 15 to October 1 for use of power scows, tugs, and barges. Craft of these types, drawing up to about 12 feet, can proceed up the river with local knowledge some 12 miles from the mouth. In order to do this, vessels leave Naknek village 1 hour before high water. Beyond this point, small boats of 3-foot draft can proceed as far as the rapids, a distance of about 7.5 miles.

An overhead power cable with a clearance of 48 feet crosses Naknek River about 1.3 miles above Morakas Point.

See appendix for dates of ice breakup and freezeup.

All active canneries maintain radio communication with the Alaska Communication System.

The only marine railways in the Naknek River are those which each cannery maintains. These have a capacity up to 70 tons, draft of 10 feet, and approximate length of 120 feet. Limited repair facilities, including machine work, are available at the canneries, as well as fresh water in any quantity. During the fishing season, fresh water is available at the main ship anchorage by water barge.

Naknek (1960 population 249; P.O.) is on the north bank of the Naknek River about 1.5 miles from the mouth. A nurse is on duty during the winter, and, during the cannery season, each cannery employs a doctor whose services are available to the public for a fee. Weekly mail service is by plane throughout the year. Regular scheduled steamers also carry mail during the summer. A road leads 0.8 mile inland to a lake used as a landing place for floatplanes; another road goes about 12 miles southeasterly to **King Salmon Airport.** Transportation over land in this area is entirely by plane. Several floatplanes at the inland lake are available for hire or charter. The airport has scheduled freight and passenger service to Anchorage. There is a telephone line from Naknek to the airport.

Diesel oil, gasoline, and lubricating oil are available in quantities sufficient for normal demands, and limited amounts of coal and stove oil also are available. Delivery can be made alongside the fuel dock for vessels drawing up to 10 feet at better than half tide or by drums to ships at anchorage. There is no fuel oil. Provisions in limited quantities are available.

South Naknek (1960 population 142; P.O.), on the south bank of the Naknek River directly across from Naknek, has a school and a cannery that operates a general merchandise store.

See Appendix for **King Salmon climatological table.**

Bristol Bay Cannery Light (58°46′ N., 157°04′ W.), 51 feet above the water, is shown from a water tank 2.5 miles north of Naknek River entrance. The cannery wharf bares at low water.

Libbyville, on the east side of Kvichak Bay, 3.5 miles north of Naknek River entrance, has a cannery with a 100-foot long wharf.

Common practice in this area is to avoid all movement of vessels north of Naknek River at the lower stages of the tide or on a falling tide. At or near high water it is safe to navigate almost any part of the area with vessels drawing up to 7 or 8 feet; vessels going aground on a rising tide are floated in a very short time and may proceed. No rocks exist on the shoals, and temporary groundings do not often damage vessels.

Most of the area between Naknek and Kvichak Rivers bares at some stage of the tide.

The Bend Light (58°50′ N., 157°00′ W.), 56 feet above the water, is shown from a small white house. The light serves as a useful aid to vessels and barges of shallow draft using the eastern channel from Libbyville to Koggiung where depths vary from 3 to 20 feet at low water. Local knowledge is necessary to avoid grounding on a falling tide.

Koggiung, a village on the east bank of Kvichak River, has several canneries. All of the wharves are dry at low

water and have mud bottom alongside. All have fresh water connections. Fuel oil, diesel oil, and gasoline are stored for cannery use.

The longest wharf at Koggiung is 450 feet. The marine railway at this wharf can haul out vessels up to 60 tons at high water.

Kvichak River, from Koggiung to Iliamna Lake, is 50 miles long. In the upper half of its course it is much broken by islands and bars into narrow, shallow channels. The lower half is tidal.

Occasionally vessels drawing 14 feet have ascended the river as far as the mouth of Alagnak River, but anchorage is difficult to find. Kvichak River is navigable for cannery tenders of 10-foot draft to **Alagnak River,** 22 miles above the mouth of Kvichak River. Launches of 3- to 4-foot draft can go on up into Iliamna Lake.

On Kvichak River there are four recommended anchorages where mooring buoys are maintained during the fishing season. Fresh water is available at the canneries.

At **Graveyard Point** near the mouth fair protection is available in depths of 10 to 12 feet in all weather except strong southeasterly storms. The bottom is fine gray sand with good holding ground.

Graveyard Point Light (58°52′ N., 157°01′ W.), 50 feet above the water, is shown from a small white house on a pyramidal structure 0.7 mile south of Graveyard Point.

Off **Nakeen** and the mouth of **Squaw Creek** good protection in all weather is afforded in depths of 15 to 17 feet. The bottom is fine gray sand and the holding ground is good.

At **Kvichak** good protection is afforded in depths of 8 to 10 feet in all weather except a strong northerly storm. The bottom is gray sand and the holding ground is good.

At **Levelock** (chart 8802) (1960 population 88; P.O.) good protection is afforded in all weather, in 8 to 10 fathoms, fine gray sand bottom, with good holding ground.

Common practice on the Kvichak River is to restrict navigation to the direction of the current and to a stage about half tide, if possible. Vessels grounding on a rising tide are floated in a short time and temporary groundings cause no damage since there are no rocks on the shoals.

Local knowledge of the channels is necessary and anyone not thoroughly familiar with the river is strongly advised to obtain a pilot from one of the canneries.

Chart 8502.—Iliamna Lake is about 70 miles long and generally from 7 to 17 miles wide. It is about 50 feet above tidewater. Reported soundings indicate a depth at the east end of many hundred feet. The lake is usually frozen from late December until late in May; the snow leaves the low ground in April, remaining until June in the pass between Iliamna Lake and Cook Inlet. Some snow may be expected in September, but the ground is not permanently covered at low altitudes until some months later.

Old Iliamna is an abandoned village 3.5 miles above the mouth of the **Iliamna River** which drains into the eastern end of Iliamna Lake.

A trail leads from the head of Iliamna Bay, Cook Inlet, to Old Iliamna, a distance of 10 miles, crossing a 900-foot summit 3 miles west of the bay. Another trail leads from the western arm of Iliamna Bay to Old Iliamna, 17 miles, crossing three summits 1,700, 1,500, and 1,975 feet high, at 3.5, 5, and 13 miles, respectively, from Iliamna Bay, descending to 1,400 and 600 feet between the summits. These trails can generally be used by horses from June to November. Dogs are used during the remainder of the year.

Old Iliamna can also be reached by a portage from the head of Kamishak Bay, Cook Inlet, to the head of **Kakhonak Bay,** an arm of Iliamna Lake. The portage is said to be an easy one over a low pass, but it is not much used except by natives because of the difficulty of landing supplies on the uncharted coast of Kamishak Bay.

From Old Iliamna all parts of Iliamna Lake and Kvichak River can be reached in boats. Gasoline launches are available at the village.

Newhalen River, about 20 miles long, connects Iliamna Lake with Lake Clark. The upper 10 miles can be navigated by canoes and poling boats. Rapids and reported falls make even canoe navigation impossible for the lower 10 miles. These rapids may be avoided by a 5-mile portage.

Iliamna (1960 population 47; P.O.) is near the mouth of Newhalen River. An airfield is adjacent to the village.

Lake Clark is about 45 miles long and from 1 to 3.5 miles wide. It is about 220 feet above tidewater, and is tributary to Iliamna Lake and Newhalen River.

Chart 9052.—Nushagak Bay and **Nushagak River,** on the north side of Bristol Bay near its head, are important for the extensive salmon fishing and a number of large canneries which are operated during the summer. The bay is 15 miles wide at the entrance between Protection Point and Etolin Point. The surveys of 1948–50 show that the bars and channels in the upper bay and river have changed considerably. Local authorities state that the area between Clarks Point and Dillingham (Snag Point) is particularly subject to change on the ice run-out each spring.

Nushagak Bay and River are obstructed by extensive shoals near the shores, and by long bars, partly bare at low water, which generally extend in the direction of the channels. In the absence of aids, navigation is safe only in the daytime when the marks and distant peaks can be seen. The worst dangers in the approach are the extensive shoals southward and southeastward of Cape Constantine, the outer one being nearly out of sight of land.

Northward of Dillingham is a sparse growth of timber, which becomes heavy farther inland but to the southward are only occasional clumps of alder bushes.

The peninsula of **Cape Constantine** is low rolling tundra country, with bluffs in places. **Nichols Hills,** 125 feet high, are small sand knolls, the highest part of a ridge that follows the eastern side of the cape, and lie 5 miles northwestward of Protection Point.

At the southwest end and on the southeast side of

the cape are the entrances of two lagoons that can be entered by boats at high water when there is no surf. At low tide, water remains in the entrance and for a short distance inside the first lagoon; the second lagoon is bare.

Shoals with little water on them in places extend 6 miles southward from Cape Constantine, and the outer shoal, Ustiugof, lies 8 to 9 miles southeastward from the cape. These shoals are in the form of long ridges trending in the direction of the set of the tidal currents around the cape to and from Nushagak Bay. They are steep-to, especially on the offshore side, and soundings will not give sufficient warning to avoid them. The tidal currents northeast of **Sterling Shoal,** off Cape Constantine, have a velocity of about 2 knots. See the Tidal Current Tables.

Ustiugof Shoal is a narrow ridge with a least depth of 13 feet, and has a length of 15 miles in a 052° direction. Close to its southeast side are depths of 11 fathoms or more. From a vessel near the shoal, Cape Constantine can be seen in clear weather. The greatest care is required when southward or southeastward of the cape. The shoaler ridges are generally indicated by rip or breakers at low water, but there is generally nothing to indicate Ustiugof Shoal.

Protection Point, the eastern end of Cape Constantine, is a low marshy spit which extends 1.5 miles from the higher land. On the north side of the point, 2 miles westward of its end, is the entrance to a lagoon; small boats can anchor in, or close inside the entrance, but the current is strong on the ebb. The current velocity off the point is about 2 knots on the flood and 3 knots on the ebb; see the Tidal Current Tables. A narrow shoal awash in places at low water extends 4.2 miles southward from the point. The southern half of the shoal is about a mile from shore; between the point and the north end of the shoal is a narrow channel. A detached shoal about 2 miles eastward from the point has a least depth of 15 feet.

Nichols Spit, eastward of Nichols Hills, forms a cove, dry at low water, that can be entered by boats at high water and affords shelter except from northerly winds.

Igushik River is a crooked winding river on the west side of the bay; vessels up to about 24-foot draft have been taken out. The channel into the river is not surveyed. The flat on the eastern side of the channel leading to the mouth of the river shows for nearly its full length at low water. The bar at the entrance of the channel has depths of 5 to 14 feet on it, and lies about 7.5 miles southeastward of the mouth of the river and 8.8 miles northward from Protection Point.

Igushik Ridge, on the west side of Igushik River, is prominent, being about 260 feet high near its northern end, where it breaks sharply to the river. The peninsula eastward of the river is low.

Snake River, 10 miles north of the mouth of Igushik River, is used only by fishing boats. The channel leading to the mouth of Snake River has a depth of about 8 feet, and is well defined at low water by the flats, which uncover, except at the entrance.

The land on the eastern side of the bay is low and rolling tundra, and the entrance point is rounding without a distinct point.

Etolin Point, the larger rounded point between Kvichak and Nushagak Bays, is flat, tundra covered, with several shallow lakes, some of which have been used for float-plane landings. The western extremity of the point is a 90-foot high bluff. A 149-foot high rounded hill, 2 miles eastward of the point, is a prominent landmark when approaching from seaward.

Shoals covered less than 12 feet extend 5 miles southward of the rounding point southeastward of Etolin Point, while depths of 30 feet or less are more than 10 miles from the shore. The shoaling is gradual, and sounding is a good guide in approaching the eastern shore when just outside a line joining Etolin and Protection Points. Above this line in the eastern half of the bay there are long shoals, most of which show in places at low water.

Ekuk Bluff, northward of Etolin Point, is 170 feet high and prominent. **Ekuk** (1960 population 40) is a native village on a spit at the north end of the bluff. The lagoon inside the spit is bare at low water. The cannery wharf at Ekuk is 150 feet in length with 7 feet alongside at high water. Gasoline, diesel oil, and fuel oil are stored for cannery use and fresh water is available. A small marine railway can handle vessels up to 60 tons at high tide. The cannery maintains radiotelegraph communications with the Alaska Communication System.

Clarks Point, 1.5 miles north of Ekuk, is low and has an extensive gravel beach. On the point are a large Alaska Packers Association cannery and the village of **Clarks Point** (1960 population 138; P.O.). The ridge, 169 feet high, terminates in a bluff at the shoreline 0.6 mile south of the point and is prominent from seaward. Several large water tanks near the shore end of the bluff are prominent landmarks.

The Alaska Packers Association wharf at Clarks Point is 175 feet long and has a depth alongside of about 8 feet at high water. A temporary T-pier with a face of 80 feet and a depth alongside of about 13 feet at high water is extended out 90 feet from the face of the main wharf during the cannery season. The main wharf has a 20-ton crane on the northeast corner and a 3-ton crane on the southwest corner. Radiotelephone and radiotelegraph communications are maintained with the Alaska Communication System.

Water is piped to the wharf. A general store is operated throughout the year. Gasoline, diesel oil, and fuel oil are stored for cannery use. The marine railway can haul out vessels up to 150 tons at high tide; a small machine shop is nearby.

Clark Slough, 1.5 miles northeastward of Clarks Point, is navigable for launches at high water for about 17 miles. The bar which must be crossed at the edge of **Combine Flats** when entering the slough bares at low water. Fishing craft and tenders use Clark Slough and the part of Combine Flats behind Clarks Point for shelter during heavy southwest weather. Mooring piles are maintained by the Alaska Packers Association on Combine Flats near Clarks Point.

Nushagak Point, on the east side of Nushagak Bay and 7 miles northward from Clarks Point, is the outer end of a prominent 250-foot ridge, to the eastward of which is a deep valley. **Nushagak,** a small village on the point has two unused canneries, a school, and a church. There are no wharves. Vessels may approach as closely as their draft permits and use small boats or barges for reaching the shore. Landing at low water is difficult because of the very sticky mud on the flats, but a good landing can be made on the gravel beach at high water. Nushagak has no post office, mail being received through Dillingham, and no supplies are available.

From **Coffee Point** to **Snag Point,** 9 miles to the northeast, the western shore of Nushagak Bay consists mostly of bluffs. **Bradford Point,** between Coffee Point and Snag Point, is opposite **Grassy Island,** which is awash at highest tides.

Kanakanak, at Bradford Point, is a small settlement which includes the former sites of Dillingham and Kanakanak and is connected by roads with the present site of Dillingham at Snag Point. A hospital and a radio station are operated at Kanakanak by the U.S. Public Health Service.

Dillingham (1960 population 424; P.O.) is the principal settlement and source of supply in Nushagak Bay. The village has a school and churches, and hospital facilities at Kanakanak may be reached by road. Ordinary supplies are available at several general stores. Petroleum products, except fuel oil, can be obtained from the Standard Oil Co. plant. Fuel oil for the canneries in Nushagak Bay is generally brought in by tanker early in the season and transferred to cannery barges at the anchorage off Clarks Point. Limited quantities of fuel oil can be obtained from the tanks of supply vessels handling general cargo for the bay.

Vessels drawing 23 feet ascend the bay on high tide and anchor just below Snag Point. Supplies are lightered to Dillingham either by the canneries' equipment or by private equipment. The oil and cannery wharves can be approached only at high tide; vessels drawing 12 feet moor at these wharves on higher high tides.

The cannery at Dillingham has a wharf 178 feet long with a depth alongside of 2 feet at low water and can be used by small tenders at high tide. Gasoline, diesel oil, and fuel oils are stored for cannery use. The cannery maintains radiotelephone and radiotelegraph communications with the Alaska Communication System. A marine railway at the cannery can haul out vessels up to 100 tons at high tide.

Dillingham Harbor, on the west side of Dillingham, provides moorage for small fishing and pleasure craft. In June 1962, the controlling depth was 2 feet in the entrance channel and basin.

An airport 0.5 mile north of the village, provides air services the year round. A commercial radio station maintains regular schedules with the Alaska Communication System. Incoming vessels may request local pilots through this station.

Wood River has its entrance northward of Snag Point, and has a length of about 24 miles to **Lake Aleknagik.** Its width varies from about 600 yards in its lower part to about 50 yards where it joins the lake. A depth of 3 to 3½ feet at low water can be carried 15 miles up river and not more than 2½ feet to the lake; at high water 4 feet can be carried this distance. The lake is about 24 miles long and navigable for its entire length.

A cannery, on the south bank of Wood River, is just inside Snag Point. The mudflats in front of the cannery wharf bare at low water. Gasoline, fuel, and diesel oils are stored in small quantities for cannery use. The tenderway, only skid shoes, can haul out vessels up to 75 tons at high tide.

Prominent features.—Northward of Nushagak Bay is a chain of prominent mountains, which are snow-covered in early summer but are bare except in the ravines by the middle of July. In clear weather the peaks show from a long distance seaward, but much of the time they are obscured by clouds and haze. Many of the summits are shown on the chart.

Channels.—The controlling depth in Nushagak Bay and River is about 10 feet to Dillingham, 30 miles above the mouth. Small vessels of 2½-foot draft can continue up Nushagak River to **Nunachuak,** 100 miles above the mouth.

Anchorages.—Vessels can anchor in the outer part of Nushagak Bay in northerly weather. The wind from this direction does not appear to blow with force during the summer. This part of the bay is exposed to a heavy sea during easterly to southerly weather. The strong current causes a vessel at anchor to lie stern or broadside to the sea when the wind opposes the current. The bars seem to afford little protection. In southwesterly and northeasterly weather, the western and eastern sides of the bay, respectively, should be selected.

Good anchorage can be found southward of Ekuk Bluff, in 30 to 35 feet, mud bottom, where the current is not strong. During the cannery season, mooring buoys, placed in a line parallel to the beach, are maintained for tally barges in the area south of Ekuk Bluff and east of the main channel.

In southwesterly weather, good anchorage in about 18 feet is offered to vessels drawing 12 feet or less, 1 mile 021° from Protection Point. Deeper draft vessels should anchor farther northeastward.

Above Ekuk good anchorage will be found wherever the depth will permit. This part of the bay is very choppy in heavy weather, but the sea seldom, if ever, is heavy enough to endanger a vessel. The bottom is sand, but the anchor holds well if given a scope of about 60 fathoms. The currents are strong, and care should be taken to avoid dragging. Vessels remaining long are anchored in line in the channel to interfere as little as possible with the nets. During the cannery season, mooring buoys are placed by the canneries in lines parallel to the channel off Ekuk Bluff and Clarks Point.

Tides.—The tides in Nushagak Bay are influenced to some extent by strong winds. The diurnal range of tide at Clarks Point is 19.5 feet. Daily predictions are given in the Tide Tables.

Currents.—The currents in Nushagak Bay have con-

siderable strength; velocities of about 4 knots have been observed on both the flood and the ebb. The ebb usually begins shortly before high water and continues to run after low water, roughly about 7 hours ebb and 5 hours flood. The period of slack water is usually short. The currents generally set fair with the channels, but in navigating the bay the course is often across the current and allowance must be made for it. The velocity is influenced by freshets and continued winds, which also affect the times of slack water. A current of over 5 knots may be experienced at times. See Tidal Current Tables for predictions in Nushagak Bay.

Weather.—The weather is variable, but it is considered better than farther westward. Spells of bad weather occur, and their duration increases in the late summer. Southwesterly winds sometimes predominate in the early summer and easterly winds later. Easterly winds bring thick weather and rain, and are accompanied by low or falling barometer. Southwesterly winds, if moderate, bring fair weather, but if strong bring rain. Northwesterly winds bring fine clear weather, but seldom blow steadily. In settled weather the wind may be light from any direction, accompanied by showers. After a gale there is usually no shifting of the wind or sudden breaking of the storm, but the wind decreases, and there is a gradual return to fair weather. Fog sometimes sets in from sea, but there is little fog during the summer.

Ice.—The movement of the ice is variable, depending upon the direction of the wind. It is said that the arrival of cannery vessels has been as late as June 17. The ice is not solid but drifts in floes with the wind and current. Northeast winds drive the ice out of the upper bay to ground and breakup on the shores and sand bars of the western side of the bay. Cannery floating equipment is hauled out upon completion of the season in mid-August and the salmon pack is taken out at that time. One winter supply vessel generally makes the last trip into the bay about the middle of September. See Appendix for dates of ice breakup and freezeup.

Routes.—The channels and bars of Nushagak Bay and River are probably subject to constant change, due to the action of currents, and to a smaller extent by the action of the sea. Changes of considerable extent are reported by those of long experience. A margin of safety should therefore be allowed for the soundings found by the survey. It is also well to remember that with a very low tide the water may fall as much as 4½ feet below the plane of reference of the chart.

The navigation of the bay is not easy, and a stranger should proceed with great caution. Tide rips may be taken as good evidence of shoals. The shoals are long ridges trending in the same directions as the tidal currents, and the danger of stranding is greatly increased if a course is laid across the currents. A stranger should navigate only on a rising tide and is advised to communicate by radio with the commercial station at Dillingham, or with one of the canneries, and arrange to have a pilot sent out.

It is recommended that vessels bound to Nushagak make Cape Greig, which is high and easily recognized and marked by a light, then shape the course for the entrance lighted bell buoy, favoring the Etolin Point side in preference to the Cape Constantine side. The currents that may be experienced when crossing from Cape Greig are not known, but there may be considerable set. Great care should therefore be exercised in approaching the entrance. The land at the entrance when first seen in approaching is indefinite, and presents no feature that can be readily identified.

After making the entrance buoy enter the bay on the 341° lighted range through **Ship Channel.** Favor the eastern side of the range until clear of the 6-foot spot on the eastern edge of **Long Sands** and take care to avoid the 3- and 4-foot spots near the edges of the channel through the north end of the bar. When through the cut on the bar, leave the range and follow the general trend of the shore to off Ekuk.

Note.—On the flood, just inside the bar, cross a distinct rip and keep it about 150 feet off the port side. The waters of the upper bay and river carry heavy sediment, and the only indications of shoals usually are swirls or rips. On the ebb the waters of the upper bay are practically fresh but they become brackish on the flood.

From Clarks Point to the upper canneries, numerous mud and sand bars are exposed at low water in the central and western parts of the river. Shoal water in the middle of the river is extensive and restricts crossing during low water; nearly all navigation of this section is done on a rising or high tide. Navigation of this area should not be attempted by large vessels except on a rising tide and then only with local knowledge or with a local pilot. Local authorities state that the area is subject to change on the ice runoff each spring.

Present traffic follows the eastern shore above Clarks Point, keeping about 1 mile off. The channel follows close along the edge of the eastern mudflats and is marked by local buoyage during the summer. The western line of this buoyage marks the east edge of the channel and the other two or three lines mark set-net sites. The channel is 0.8 mile offshore at the northern end of Combine Flats and 0.5 mile off at Nushagak Point. A mile below Nushagak Point, vessels cross over and pass 0.2 mile off Bradford Point, then follow the western shore at this distance to the anchorage off Dillingham. Traffic generally starts upriver on half-flood tide.

Repairs.—The large tides and the flats make it easy to beach a vessel of drafts up to about 18 feet. A good place is at Clarks Point. Small machine repairs can generally be done at the companies' shops.

Communications.—The Alaska Steamship Company makes several trips a year into the Nushagak Bay area, the earliest being about May 15 and the latest about September 15, depending upon ice conditions. Commercial airlines serve the area. Dog teams are used to some extent by natives and trappers during the winter and small boats are used for local travel during the summer. Tankers and barges bring in diesel oil, gasoline, lubricating oil, and fuel oil. All canneries and their tenders are equipped with radiotelephone and radio traffic can be handled through the cannery shore stations during the

season. Radiotelephones are maintained by cannery caretakers during the winter.

Chart 8802.—The area between Cape Coustantine and Cape Newenham is unsurveyed, and there are indications that the present charts are considerably in error. Vessels laying a course from ontside Ustiugof Shoal to pass about 2 miles off Cape Peirce, in thick but otherwise moderate weather, have reported making Hagemeister Island dead ahead. This undouhtedly is due to a northerly set in this vicinity. In the thick weather which prevails in this locality safety is assured only hy constant sounding.

Kulukak Bay, entered between **Kulukak Point,** 38 miles northwestward of Cape Constantine, and Right Hand Point, about 9 miles west-southwestward, is shoal; there is a depth of 3 fathoms just inside the entrance and the northern half dries at low water. The buildings of an abandoned native village are above the bluff at the northwest corner of the hay.

Right Hand Point is the southern extremity of a mountainous peninsula which separates Kulukak Bay from Togiak Bay.

Walrus Islands, consisting of three islands and three above-water rocks, lie in the approach to Togiak Bay. A reconnaissance survey in 1948 found shoal water between several of the islands as well as south of the group. Shoaling is rapid after reaching a depth of 3 fathoms, requiring continuous sounding while navigating these waters. Thick weather is frequent in this area, and often the higher islands are fog-capped when the weather is otherwise clear. The diurnal range of tide is 9.5 feet.

Round Island, the easternmost of the group, is 1,407 feet high, and lies about 10 miles southward of Right Hand Point. The west side of the island is precipitous and bare in the lower elevations. A narrow beach makes around the east side. To the north the island terminates in a distinct pinnacle rock. A reef, bare in places and consisting of sand and smooth houlders, extends about 1.3 miles northwestward of the pinnacle rock.

Indifferent anchorage may be found about 1 mile northeast of the island in about 11 fathoms, hard sand hottom.

Crooked Island, 1,254 feet high, lies 8 miles westnorthwestward of Round Island; it is almost entirely covered by tundra. There are large coves on hoth the southwest and east sides of the island. These coves have been reported to be shoal; the 3-fathom curve extending about 1 mile offshore. The holding ground is good, hut little protection from either sea or wind is afforded a vessel anchored in 4 or 5 fathoms. Fair anchorage in southeasterly weather can be had in 5 to 6 fathoms, sand bottom, 0.5 mile west of the northern tip of the island. A bank of unknown extent, covered 2 fathoms or less, is off the west side of the island about 1 mile south of this anchorage.

High Island, the westernmost of the Walrus group, is 1,716 feet high, and lies 2 miles westward of Crooked Island; this island is steep-to on its eastern and western sides, with a few strips of sand beach. Good water can he carried around the north end of the island to the west side where anchorage, protected from the southeast, may be had. To make the anchorage, clear the north tangent of the island about 1 mile, passing over depths of 12 to 14 fathoms and anchor about 1.5 miles south of the north end and about 0.8 mile offshore in 6 to 7 fathoms, sand bottom. About 1.5 miles south of this anchorage the water shoals to less than 2 fathoms.

The Twins are two isolated rocks 4 miles southward of Crooked Island. The larger is 300 feet high; the lower and southwesterly of the two is 100 feet high.

Black Rock, 131 feet high, is 4 miles east of the northern part of Crooked Island. From the air the rock appears to be an upthrust on a submerged ridge, the axis of which parallels that of Crooked Island. Black Rock, the southeast tangent of Crooked Island, and The Twins are very nearly on range.

No other outlying dangers were seen in passing between the islands and the mainland. Except for a 6- to 10-fathom shoal abreast the group of islands, the depth gradually decreases to 3 fathoms off the north end of Hagemeister Island. The course was near the shore, however, and more water would doubtless have been found in midchannel.

Summit Island, 801 feet and 505 feet high near the southern and northern ends, respectively, lies 8.5 miles west-northwestward of Righ Hand Point, and 2 miles from the eastern shore of Togiak Bay. Good anchorage, sheltered from southwesterly weather, may he had in a bight about 0.5 mile off the middle of the eastern side of the island in 5 to 6 fathoms, sand bottom.

Togiak Bay, northward of the Walrus Islands, and about midway between Cape Constantine and Cape Newenham, is shoal; the head of the bay uncovers to the southward for 5 to 6 miles. A sunken rock lies just off the eastern entrance point of the hay. **Togiak** (1960 population 220; P.O.) is near the head of the bay.

Hagemeister Island, 9 miles west of High Island, is mountainous except for about 5 miles at the north end. Shoals surround the island and extend eastward 20 to 25 miles, including the area between Hagemeister Island and the Walrus Group.

Shoal water has been reported as extending eastward from Hagemeister Island in the direction of High Island. Ice has been observed grounded there. Foul ground is also reported as extending northward of the north point of the island.

Current observations were made in June 1948 for a period of about 10 hours at a location about 8 miles southwestward of Hagemeister Island. The current set approximately 335° and 165° with velocities at strength of about 0.8 knot and 1.5 knots, respectively.

Hagemeister Strait is about 16 miles in length between the island of that name and the mainland. It is 3 to 4 miles wide, but shingle spits contract it in two places to less than 2 miles. On a passage through the straits by the ALBATROSS, the least depth found was 4½ fathoms. Good anchorage was found under **Tongue Point,** the shingle spit making out from the mainland about midway of the channel. From the above anchorage, the

ALBATROSS stood directly to sea, passing within a mile of the southwestern extremity of Hagemeister Island; thence steered 206°, shoaling the water to 3 fathoms 7 miles from the island. Greater depths might be found by taking a more westerly course. It is reported that there is anchorage under the spits at both ends of Hagemeister Island. The tidal currents are very strong through the channel.

The Osviak River empties into the strait about 13 miles west of Tongue Point. The native village of **Osviak** is on the west bank of the river abont 3 miles from the mouth.

Cape Peirce, of moderate height and symmetrical form, lies 22 miles westward of the southern end of Hagemeister Island, and 15 miles southeastward of Cape Newenham. A shoal area, with depths of 2 to 3 fathoms over it and possibly less, is reported to extend some distance westward from the cape. Depths of 10 fathoms are found 2 miles southward of the cape, and good anchorage in 10 fathoms is found inside **Shaiak Islet,** just eastward of the cape. There are reports of good anchorage, sheltered from northerly weather, in the bight northwestward of Cape Peirce. To make the anchorage from eastward, give Cape Peirce a herth of about 3 miles and steer 009° for the junction of the northwest end of the sand beach with the rocky shores; select anchorage at will off the sand beach. The approaches from westward are clear except for the above mentioned shoal.

Charts 9103, 9302.—Kuskokwim Bay and **Kuskokwim River** open into the Bering Sea north of the entrance to Bristol Bay. The bay, filled with many flats, and hard steep-to shoals, is entered between Cape Newenham and **Cape Avinof,** 93 miles northwestward.

The channels through the bay are not always apparent by the surface indications of the water. At times the channels will be smooth with rips on the shoals, and at other times the reverse will be true. The edges of the channels are often marked by long lines of foam, but occasionally the foam extends across the channels; it is well to approach these lines with caution. Navigation is recommended only at low water, when the mudflats are visible, enabling the channels between them to be followed. Owing to the inequality of the tides, a vessel grounding at high water may not be refloated for several days.

The 40-mile approach through **Eek Channel** to Kuskokwim River is a maze of shifting sand bars, both visible and covered, and blind channels. The channels in the bay and river undergo constant change from year to year, due to the action of the sea, currents, and ice; extreme caution and continuous sounding is necessary.

The procedure usually followed is for a small pilot boat from Goodnews Bay to precede the vessel through these waters, constantly feeling out the channels and sounding.

During southerly storms a heavy sea makes up the bay nearly to Eek Island, at the head of the bay, and vessels caught on a shoal are in danger of breaking up.

The channel through Kuskokwim Bay and up Kuskokwim River to Bethel is marked by buoys maintained from June 15 to September 30. The deepest draft that should attempt to reach Bethel is about 15 feet.

Cape Newenham is the landfall for this region, and can be approached close-to with deep water. It is the end of a peninsula formed by a series of rough sawtoothed mountains. These mountains terminate in a level plateau which forms the immediate cape. In southerly weather a heavy sea and tide rips occur off Cape Newenham. Satisfactory anchorage for southerly or easterly weather can be had in about 8 fathoms off the small cove on the north side of the cape and about 3.5 miles from its outer end.

Jagged Mountain is a well-defined peak, the highest of the Cape Newenham group. Viewed from northward, its slopes appear jagged.

Security Cove, 9 miles northeastward of Cape Newenham, is a good anchorage except with northwest winds; the usual summer gales are southeasterly. The bottom is even and shoals gradually. The best anchorage in 3½ fathoms, mud bottom, is about 0.8 mile northeastward of Castle Rock and on the range of Castle Rock and the first promontory southwestward. Fresh water can be obtained from a stream which enters the cove. There is also good anchorage in 2 fathoms with good holding ground in the middle of the bight on the southwest side of Castle Rock. This anchorage is less affected by the ground swell making along the coast from Cape Newenham than the anchorage in Security Cove.

Castle Rock, the southwest point of Security Cove, is a small prominent headland, 260 feet high, joined to the land by a low neck. At the northeast point of Security Cove is a conspicuous pinnacle rock, 169 feet high, covered with light tundra.

Chagvan Mountain, between Security Bay and Chagvan Bay, is smooth shaped and terminates in two high rounded knobs.

Chagvan Bay has a narrow shoal entrance. Inside it is very shoal and cut up by bars that are bare at low water.

Red Mountain, just south of Goodnews Bay, is a reddish color and conspicuous. From northward it appears as a long ridge with the highest part at its northern end.

Goodnews Bay is shoal except for a 11-foot channel which leads through the entrance to a point about 1 mile inside. This channel affords good anchorage, either in the middle of the entrance or up to 0.8 mile inside the bay on a line approximately northeast of the south tangent of the north spit. The diurnal range of tide is 8.9 feet. Inside the entrance the strength of the tidal currents reaches a maximum of about 2.5 knots in a direction parallel to the axis of the channel. See Tidal Current Tables for predictions. Along the northeast shore of the south spit the ebb current is very strong, and during the flood an eddy sets northward along this shore. The holding ground is good. Small craft can select from the chart a place that affords the best shelter. A restricted anchorage for small vessels is about 1 mile southward of the south entrance point, but local knowledge is necessary for its use. The sea from the outside is broken by the shoals off the entrance and does not reach the anchorage. With southerly or easterly

winds, tide rips dangerous for small craft occur in the channel. The spits at the entrance are shingle and steep-to.

Platinum (1960 population 43; P.O.), at the inner end of the spit on the south side of the entrance of Goodnews Bay, is the headquarters of a mining company and of most of the commercial activity in this area. The village has semiweekly airmail service during the summer and weekly service during the winter; an airplane landing strip is here. Radiotelephone and radiotelegraph communications are maintained with the Alaska Communication System.

Groceries, general supplies, petroleum products, and fresh water are available at Platinum. The small-boat basin just south of the oil-storage tanks on the northeast side of the south spit can be entered only at high water as the entrance bares at low water. A road leads from the village to the storage tanks and boat basin. The platinum mines are about 15 miles southeast of the village. Prior arrangements can be made to have a pilot meet inbound vessels off Goodnews Bay for the trip north.

Beluga Hill is a prominent conical hill 924 feet high, with a steep, rocky face that rises abruptly from the north side of Platinum Bay. Although lower than the mountains behind it, the hill usually stands out prominently from all parts of Kuskokwim Bay.

To enter Goodnews Bay from a point about 2.5 miles south by west of the entrance, stand in on the northeast-southwest range on course **037°** until the east-west range, nearing 090½°, closes; then steer **000°** for about 0.7 mile or until abeam of west tangent of the spit; then follow the south spit at a distance of 0.25 mile, and cross the entrance to the small-boat anchorage.

To go to the anchorage in the northern part of the bay, round the north spit at a distance of 300 yards nnd steer **312°** for the high bluffs on the west side of the bay. Hold this course for about 2 miles, or until the eastern side of Beluga Hill is in range with the flat-topped mountain just back of Goodnews village. Then head up for Beluga Hill and hold the range until up to the anchorage under the mountain.

About 6 feet of water will be found here at low tide. In 1913 the survey ship YUKON laid at anchor here during a northerly gale. There is no protection in southerly or easterly weather. A stream enters the bay here. The bay has a good shingle beach.

It should be noted that this route has not been surveyed, and there may be, in places, less than 6 feet at low tide. This route should be used with caution and only on a rising tide. Keep sounding constantly. On the bluffs at the foot of Beluga Hill is a cabin.

The UNITED, drawing 16 feet, was taken into Goodnews Bay. Good anchorage is reported in 7 to 11 fathoms, 2 miles north-northeast from the bay entrance on line to Beluga Hill. This indicates that deep water can be carried farther into the bay in the main channel than is indicated on the chart.

Goodnews (Goodnews Bay P.O.) is a small village with a school at the head of Goodnews Bay. The channel to the village is shallow and winding so that local knowledge is desirable, but can be followed by small boats at low water when the bars are visible.

Carter Spit, on the east side of Kuskokwim Bay, is a low sandspit about 4.5 miles long and from 50 to 300 yards wide. Carter Spit incloses **Carter Bay,** which is a wide area of shoals and mudflats. Around the end of the sandspit a narrow channel is scoured out, affording anchorage for launches and small craft, but without protection from northward. A small stream, known as **Indian River,** flows into the east side of Carter Bay near two abandoned cabins formerly called **Carter.** Fresh water can be obtained by boats from Indian River at high water.

Explorer Mountain is the highest peak northward of Goodnews Bay. From southward it appears as a long ridge, and is recognized by three deep gulleys on its side. From westward it appears as a pyramid peak, the highest of the group.

Tooth Mountain, a flat-topped mountain in the front range, has a sharp, rocky pinnacle on the northern edge of its summit. It is easily recognized from the vicinity of Carter Spit.

Figure IV Mountain is a sharp peak in the front range eastward of Jacksmith Bay. The deep ravines on the side of this mountain form a numeral IV, which is conspicuous from westward when the ravines are filled with snow. In the later part of the summer, the snow disappears from the ravines.

Cone Mountain is a large conical mountain in the first range.

Yukon Hill is low but is the north end of the front range paralleling the coast; it is visible from the entrance of Eek Channel. From westward the hill is not distinguishable, as it has the receding range for a background.

Thumb Mountain is a fairly sharp summit in the range that recedes from Jacksmith Bay. From off Quinhagak it resembles a huge thumb placed on a high flat mountain plateau. As Eek Island is approached, the mountain appears as a less distinctive ridge.

Jacksmith Bay, the large indention 14 miles northward of Carter, it bare at low tide.

Quinhagak (1960 population 228; P.O.), 66 miles north of Cape Newenham, is difficult to approach by water because of the great mudflats bordering its shores. Launches can enter the creek here only at the highest tides, and even small craft can hardly get within sight of the village and remain afloat at low water. Supplies are landed with great difficulty, owing to the extensive flats and their exposure. Quinhagak has a Moravian mission, a store, and a school. Radiotelegraph communication is maintained with the Alaska Communication System. A limited amount of supplies may be procured. The church steeple is sometimes visible from Eek Channel. **Kanektok River,** entering Kuskokwim Bay at Quinhagak, runs fine clear mountain water at all stages of the tide.

Warehouse Bluff, a long dark-colored bluff about 11 miles northwestward of Quinhagak, is an important landmark, as it is the first land on the east bank to be sighted

when ascending Eek Channel. No objects on the west shore are visible until approaching the head of Eek Channel.

Warehouse Creek, 2 miles above Warehouse Bluff, is deep and can be approached through a long tortuous channel that can be followed by small craft when the mudflats are bare. Small craft may find shelter here. The greatest range of tide in the bay occurs in the vicinity of Warehouse Creek. Inside the creek there is just swinging room for a 75-foot vessel riding to 15 fathoms of chain.

In the early days trading schooners ascended the bay only to Warehouse Creek. Natives and traders from various bay and river points assembled here to await the coming of the schooner. At one time some small warehouses were built here, but no trace of them now remain.

Kuskokwak Creek flows into the east side of the bay 4 miles southward of Beacon Point. It is approached through a short channel across the flats and affords a good shelter for launches and other small craft. Just inside the mouth of this creek is a depth of 4 fathoms.

At **Cape Avinof,** on the western side of Kuskokwim Bay, the east shore of Bering Sea turns northwestward.

Kwigillingok (1960 population 344; P.O.) is a native village on the west side of the entrance to the bay. Radiotelegraph service is maintained with the Alaska Communication System.

Beacon Point, 12 miles north of Warehouse Bluff, is flat and barely above storm high water. A line between Beacon Point and **Popokamute,** a native fishing village on the west shore opposite Beacon Point, is considered the dividing line between Kuskokwim River and Kuskokwim Bay. The west shore of Kuskokwim Bay has not been surveyed.

Eek Island is a grass-covered mudflat cut up by deep sloughs, and is covered by the higher tides. The island is a feeding ground for many thousands of ducks and geese.

West Point is a fishing camp on the west bank of the river just above Eek Island. The mudbank making out from West Point has extended itself considerably since the time of the survey.

Eek River is a large tributary flowing into the Kuskokwim on its eastern side just above Eek Island. It is navigable by launches for 15 or 20 miles. The river rises in the mountains about 60 miles distant; its waters are muddy and silt laden.

Eek (1960 population 200; P.O.), on the east bank of the Eek River about 8 miles by boat from its mouth, is a large Indian village with a general store and school. Daily radio schedules are maintained with Bethel. Limited supplies of gasoline and canned goods are available.

Bethel (1960 population 1,258; P.O.), 65 miles up the Kuskokwim River, is considered the head of ocean navigation. From here river boats operate to points on the upper river. The diurnal range of tide is 3.4 feet, but the stage of the river influences the depth.

See appendix for **Bethel climatological table.**

At Bethel are a Moravian Mission, a school, and several stores which are the distributors for the Kuskokwim district. The Alaska Communication System station maintains regular schedules. Provisions, gasoline, and fuel oil are available. A limited amount of coal is kept on hand.

A large well-equipped airfield and radio station are across Kuskokwim River from Bethel. Daily airmail and transportation services with other parts of the United States are maintained.

Communication between Bethel and the numerous outlying villages is by floatplanes.

Ocean vessels load and discharge cargo on the airport side of the river near a warehouse where supplies for Bethel, and for transfer upriver, are unloaded. These vessels make several trips during the summer between Seattle and Bethel, transporting freight and equipment which is distributed from Bethel over a large area. A considerable amount is shipped upriver on barges and river steamers to the many native villages along the river.

At **Aniak** (1960 population 308; P.O.), 125 miles from Bethel by River steamer, is an airfield. Limited supplies of gasoline, fuel oil, and provisions are available. General stores and a hotel are in the village.

Radiotelephone and radiotelegraph communications are maintained with the Alaska Communication System.

McGrath (1960 population 241, P.O.), 400 miles above the mouth, is the head of navigation on the Kuskokwim River.

Radiotelephone and radiotelegraph communications are maintained with the Alaska Communication System.

Routes.—Enter Kuskokwim Bay about 2 miles westward of Cape Newenham, and make good a **028°** course for about 6 miles until the cape bears 190°; thence steer **010°** with Cape Newenham directly astern for about 18 miles until Beluga Hill bears 065° and Red Mountain 121°. From this position, steer **341°** for about 13 miles to a position 4 miles 256° from the elbow of Carter Spit.

In thick or hazy weather a route nearer the coast may be taken as follows: Pass 0.5 mile off Cape Newenham and Bird Rock, and then make good a **070°** course for about 6.5 miles until Castle Rock, the southwest headland of Security Cove, bears 177°. Strong tidal currents occur along the north shore of Cape Newenham. From here steer **357°** with Castle Rock astern for 14 miles until the summit of Red Mountain is abeam, thence **341°** for 19.5 miles to a position 4 miles 256° from the elbow of Carter Spit.

Next steer **302°** for 5.5 miles with Beluga Hill in range with Pyramid Mountain astern, then head up the channel on a **006°** course.

Vessels should arrange to make this point at the last of the ebb, and go up the channel with the flood. After heading on the **006°** course, the long shoal on the east side of the channel should be made out, either heaping or breaking. It is only with a very smooth sea that this shoal is not in evidence at low water. After continuing on this course for about 10 miles, the long shoal on the west side of the channel should be made out, either heaping or breaking. This shoal should be followed at a distance of about 1 mile until its northern extremity is

reached. Here it becomes a mudflat, bare at about half tide, of a yellowish color with deep water close-to. This flat is the leading mark for entering Eek Channel, therefore it should always be made at low water.

From here, the track veers westward and follows the flats on the west side of the channel on a course of about 000° for some 13 miles.

It is reported that extensive changes have taken place northward of 59°36′ N. The chart is no longer a sufficient guide with respect to the channels.

In proceeding upriver the passage west of Eek Island is used. A crossover from Eek Channel to the west channel is made in an area subject to considerable change. It is generally necessary to wait for nearly high water before making a crossover to the west channel. Navigation in this region is difficult and a pilot and his launch should be employed. There are no landmarks visible; if buoys are in place the crossover is much easier.

East side of Eek Island.—The channel along the north side of Eek Island, once used by power schooners, has shoaled until it is now bare at low water and is used only by small fishing boats. Small vessels now go as far as Apokak Slough. From Beacon Point the channel follows the east bank of the river.

Passage west of Eek Island.—Once in the west channel, follow the west bank of the river southwestward of Eek Island for 4 miles. The course then bears out into the river towards Eek Island. From here the channel crosses to the east bank and continues to Bethel, crossing back and forth many times. There are no leading marks, and at some of the crossings it is necessary to wait for high water. A pilot is necessary.

Vessels coming downriver stand out to sea from abreast of Carter Spit. In entering, this track is not used because of the possibility of running up a blind channel.

Tides.—The diurnal range of tide is 12.2 feet at Kuskokwim Creek entrance and 3.4 feet at Bethel.

Currents.—The currents of Kuskokwim Bay and River are strong, attaining velocities of 5 knots at times. A strong tidal current sweeps past Cape Newenham, setting approximately north and south. Along the north side of the cape, tidal currents of about 1 knot have been observed setting northeastward and southwestward. In general, the currents set in directions parallel to the axes of the channels between the shoals. In the channel leading to Goodnews Bay, about 1 mile from the north end of the south spit, flood and ebb each has a velocity of about 2.5 knots, setting northeast and southwest, respectively. In the deep channels off Jacksmith Bay the flood current has a velocity usually of about 2 to 2.5 knots at strength, and the ebb from 2.5 to 3 knots. In the vicinity of Apokak Slough, the strongest current observed was 3.5 knots. The flood current is felt only about as far as Bethel.

By arriving at the entrance to Eek Channel on the last of the ebb, a favorable current can be carried nearly to Bethel, providing there are no delays.

See Tidal Current Tables for predictions in Kuskokwim Bay and River. Variations from the predicted times and velocities, due to freshets and winds, may be expected.

Weather.—The best weather usually occurs in March and April. During the summer, southeast to southwest gales are frequent and last from 2 to 5 days. These storms gradually blow themselves out and are generally followed by a few days of good weather. In the early fall, northerly winds are frequent and are usually accompanied by clear skies. After mid-September, strong gales become frequent and prolonged.

See appendix for dates of ice breakup and freezeup.

Pilotage.—The services of a pilot should be arranged for by radio to allow sufficient time for him to meet the vessel at Goodnews Bay. The pilot generally uses a launch and proceeds ahead of the vessel. There is no established fee for such pilotage.

Fresh water can be obtained from small streams in Security Cove, Goodnews Bay, and Carter Bay. In the vicinity of Eek Island, the river water is fresh at all stages of the tide; it is very muddy but the silt settles readily.

Chart 8995. The **Pribilof Islands,** in the Bering Sea about 200 miles northwestward of Unimak Pass, consist of St. Paul, St. George, Otter, and Walrus Islands; the latter two are small and uninhabited. St. Paul and St. George have the largest and most numerous fur seal rookeries in the world. The group is under the jurisdiction of the Bureau of Commercial Fisheries and is patrolled during the sealing season by vessels of the U.S. Coast Guard, under provisions of the international treaty governing sealing. Vessels other than those of the United States Government are forbidden to land on the islands, unless a permit is obtained from the Bureau of Commercial Fisheries.

Radiotelephone and radiotelegraph services are maintained with the Alaska Communication System on St. Paul Island and St. George Island. In addition interisland radio communication is maintained.

A supply vessel of the Bureau of Commercial Fisheries makes several trips a year from early spring to late fall between Seattle and the Pribilof Islands (St. George and St. Paul).

There are no landlocked harbors about the islands, but safe anchorage is always available on the lee sides. Residents of St. Paul Island say that the prevailing winds during the summer are from the northeast, which makes Village Cove on St. Paul Island a good anchorage in all but severe southwest winds. The bottom in Village Cove is black sand and the holding ground is good. During southwest winds good anchorage is available in Lukanin Bay on the southeast side of St. Paul Island.

Weather.—Fogs are especially thick and prevalent in this vicinity in the summer, and navigation is attended with difficulty and danger. A navigator should plan to make landfalls in the Pribilof Islands during the summer based on no land being visible. One annoying characteristic of the area is very thick fog accompanying strong winds. Logs from survey vessels indicate that a typical summer day in the Pribilof Islands is as follows: Dense fog at daylight, vessels anchored 200 yards distant not visible, calm sea, light airs; by noon intermittent sun, a wet drifting fog, gentle breeze; by evening a dense fog.

winds increased to force 6. Dense fog with visibility less than 0.5 mile is more common around St. Paul Island than around St. George Island. An unusual characteristic off North Anchorage, St. George Island, was clear visibility along the shore accompanied by dense curtainlike fog to seaward.

Winds do not continue to blow from the same quarter for any length of time. From December through April winds blow from the northeast more than from the other directions. After September 1, gales are frequent and violent, and blow from all directions.

Ice.—The Pribilofs are near the southern limit of the ice in Bering Sea. On rare occasions the icefields extend as far as 35 miles south of St. George Island. In 7 years of Weather Bureau ice records at St. Paul Island, there was no sea ice at all reported in 3 years. In the other 4 years, navigation remained easy throughout 1 year and became restricted to full-powered vessels for short periods in March and April of 3 years; at no time did navigation become suspended or require the use of an icebreaker.

Chart 8993.—St. George Island (1960 population 264), the southernmost of the Pribilof Islands, consists mainly of high volcanic hills and ridges, and its entire coast is a precipitous cliff except for a few miles on the north side and short intervals at Garden Cove and Zapadni Bay. The east and west extremities of the island, **Tolstoi Point and Dalnoi Point,** are bold promontories. **High Bluffs,** on the north side of the island, 1,012 feet high, is a prominent landmark, and is visible from St. Paul Island, a distance of nearly 40 miles, on a clear day.

There are no harbors, but vessels anchor at North Anchorage, Garden Cove, and Zapadni Bay, according to the direction of the wind; the anchorages are poor except with the wind directly off the land. At a distance generally not greater than 2 miles from the island the depth of the water is but little less than the surrounding sea, and in thick weather it is not safe to depend upon soundings for picking up the land unless sure of the position. Vessels should not approach the island in less than 12 fathoms of water. There are no outlying dangers except the small reefs at Zapadni Bay and at North Anchorage. A rocky shoal covered 1¾ fathoms is 0.3 miles 078° from Tolstoi Point.

The anchorage in **Zapadni Bay,** on the southwest side of the island, in 10 fathoms, affords shelter with winds from east- northeast to north-northwest. The landing is on the open sand beach, and can usually be made with northerly winds. A reef extends about 0.2 mile offshore southward of the anchorage.

With northerly winds, a landing may sometimes be made at **Garden Cove** southward of Tolstoi Point, on the sand beach. The anchorage affords shelter from northwesterly winds, but with the exception of a small area the bottom is rocky.

Currents.—In the open water the tidal current is rotary, turning clockwise. Along the north and south shores of the island the current in general sets eastward on the flood and westward on the ebb. The largest velocity observed over a period of approximately 6 days in July and August was about 1.5 knots. With opposing wind and current, the tide rips occur off Tolstoi and Dalnoi Points. These rips are not heavy enough to be of any consequence, except that to strangers they appear to be breakers. The water is deep off both points, which can be passed close-to with safety.

On approaching **North Anchorage** from seaward, the most prominent landmarks in the village of **St. George** are the white GI roofs of a quadrangle of sheds, low down at the water's edge. The roofs loom up first through the fog. Also conspicuous is a tight group of buildings on the slope and ridge back from the beach. Most easily identified is the Greek Orthodox church whose bell tower has a green onion-shaped roof topped by a white St. Andrew's cross. Vessels should keep the street which extends through the village bearing 164°. Good anchorage will be found about 700 yards from the crane on the landing. There is swinging room for a 400-foot vessel riding to 45 fathoms of chain.

The landing is a square block of reinforced concrete next to a cutting in the rocks. The area around the landing, and for about 75 feet to seaward, practically bares at extreme low water. The landing can be used by small shallow-draft boats 3 hours either side of high water.

East Landing, just northeast of the village, is better protected from a westerly swell. A ledge awash is a short distance off the landing. If desired, a boat will come out to anchored vessels when landing is practicable.

Local magnetic disturbance.—Differences of as much as 11° from the normal variation have been observed on St. George Island.

Chart 8994.—Otter Island, off the south side of St. Paul Island, has an abrupt bluff 288 feet high at its southwest end, slopes gradually to the north, and rises again in a crater, about 150 feet high, at its extreme east end. Foul ground, marked by kelp, extends about 0.8 mile from the island on its south, southwest, and north sides. The north side, from **Crater Point** to **Northwest Reef,** is clear of dangers. Probably the best anchorage near the island is in 9½ fathoms, black sand and broken shells, with the northeast extremity of Crater Point bearing 185°, distant 0.5 mile. This island must be approached with great caution in thick weather, and at all times a vessel should keep out of kelp. A 38-foot shoal is 2.5 miles east-northeast of Otter Island.

Between Otter Island and Reef Point, St. Paul Island, the tidal currents are strong, and with heavy winds dangerous tide rips occur, especially on the ebb current.

Walrus Island, off the east side of St. Paul Island, is low, about 30 feet high, level on top, and composed of irregular masses of volcanic rock. It is very hard to pick up in thick weather. It is about 0.4 mile long and 0.1 mile wide. Anchorage can be had on either side of it, 0.3 to 0.5 mile offshore, in 10 to 15 fathoms. Landing can be made with smooth water, the best place being in a small cove at the southwest corner. The island is a bad place to make in a fog.

Parts of Otter and Walrus Islands are covered with seabirds in the breeding season, and at the proper time a

plentiful supply of eggs may be obtained. Walrus Island is a major sealion rookery and trips ashore are dangerous during the mating season.

Current observations made in July and August west of Walrus Island show that the current is rotary turning clockwise, with velocities exceeding 2 knots at times.

St. Paul Island, the northernmost of the Pribilof Islands, is about 235 miles northwestward from Unimak Pass. The west and southwest parts of St. Paul Island are high and mountainous, with precipitous cliffs at the coast. The rest of the island is a comparatively low, rolling plateau, with a number of extinct volcanic peaks scattered over its surface. **Bogoslof Hill,** 590 feet high, a conical crater near the center of the island, and **Polovina Hill,** double-peaked and 470 feet high, near the east end, are conspicuous and the best landmarks in clear weather when coming from southward. From this latter hill the island stretches away, in a low, narrow neck to **Hutchinson Hill,** about 100 feet high, on **Northeast Point.** West of **Lukanin Bay** the coast of the south side of the island is rocky, with bluffs at the points. The shore of the rest of the island is generally a sand beach, with rocks in the vicinities of the seal rookeries. A radiobeacon is just east of St. Paul and a tall tower is 2 miles northeastward of the village.

A rocky ledge covered less than 3 fathoms with no visible kelp is 5 miles northeast of Northeast Point. Kelp-marked reefs extend about 0.4 mile southeastward from the two low points southward of Northeast Point. A dangerous ledge with two rocks covered less than 2 fathoms is a mile northward of Hutchinson Hill. With a moderate swell the sea breaks over these rocks.

On the north side of St. Paul Island, depths of 5 fathoms or more are a mile offshore.

A shoal covered 2 fathoms is 7.5 miles west of St. Paul Island.

Breakers extend 0.3 mile or more off **Southwest Point.**

A dangerous ledge, usually marked by breakers, extends 0.6 mile southwestward and southward from **Reef Point,** the south point of the island.

Sealion Rock, about 0.3 mile south of Reef Point, is prominent when approaching the point from an easterly or westerly direction.

A reef extends about 0.3 mile off **Tonki Point,** the northeastern point of Lukanin Bay.

Anchorage.—The usual anchorage at St. Paul Island is westward of Village Cove between Zapadni Point and Reef Point in the vicinity of the 10-fathom curve. The bottom, in general, is sandy but rocky bottom will be found in the vicinity of Zapadni Point and Tolstoi Point. Anchorage can be found northeastward from Reef Point, off **Black Bluffs** and East Landing, and in Lukanin Bay.

Lukanin Bay has a sandy bottom and is used when westerly swells make the Village Cove anchorage undesirable. From the Village Cove anchorage the village of St. Paul is obscured by a bluff although it is in full view from the Black Bluffs anchorage.

Vessels should not attempt to ride out a gale at anchor near the islands, unless to leeward and well sheltered. The surf is apt to make quickly and is dangerous on the weather side of the island.

When approaching the anchorage off **Village Cove,** the most prominent objects seen will be the white frame house on the highest point of ground just west of the village, and the steel stacks of the byproducts plant. Vessels should steer **082°** for the stacks and anchor in about 8 fathoms with Reef Point and Sealion Rock in range.

There is no protected harbor nor satisfactory landing facilities. Vessels are often delayed at St. Paul in landing cargo and personnel due to strong winds which build up heavy seas and make landing dangerous or impossible. In Village Cove, on the west side of Reef Point, the landing is at a reinforced concrete pier just northward of the bluff point. The approach to this landing is shoal and incoming swells frequently break across the entire entrance. Extreme caution should be used when any swell is running as the swells build up as they approach the shoal water, or round the bluff point, and break unexpectedly. The pier has a face of about 100 feet with depths alongside of 3 to 4 feet. Supplies are lightered ashore by power barge or bidarkas (native skin boats). A self-propelled crane is used on the pier to load and unload lighters.

St. Paul (1960 population 378; P.O.), about midway along a peninsula extending from the south side of St. Paul Island, has small wooden dwellings painted white with dark-colored roofs, a church, a small hospital, several large buildings, and a machine shop with limited facilities. A 10-ton marine skidway is available for emergency repairs.

A commercial airline provides weekly mail and passenger service to and from Anchorage, via Cold Bay or Dutch Harbor when weather permits. A weather station and a loran station are on St. Paul Island.

See appendix for **St. Paul Island climatological table.**

Tides and currents.—The diurnal range of the tide at Village Cove is 3.2 feet. Around the island the current sets eastward on the flood and westward on the ebb, following the trend of the shore. The greatest velocity occurs at Northeast Point and between Reef Point and Otter Island. Average velocity at strength of current is 1 to 2 knots, but with continued strong winds from one direction it may be increased to 3 knots.

There are heavy rips around Northeast and Southwest Points, also between Reef Point and Otter Island, where they are worse on the ebb. The tides and tidal currents are greatly influenced by the winds.

Chart 9302.—Nunivak Island, in Bering Sea near the Alaska mainland, is about 330 miles northward of Unimak Pass. Dangerous shoals and uneven bottom have been reported and are shown on the chart; the island should be approached with extreme caution.

From westward, Nunivak Island shows gentle slopes terminating seaward in reddish cliffs 150 to 462 feet high. The highest point of the western part of the island rises to 866 feet 10 miles eastward from Cape Mohican. Near the

center of the island is **Roberts Mountain,** 1,675 feet high, the highest of a group; this monntain is built up of a series of volcanic benches, the top being the steep side of a breached crater. The east end of the island is low, for the most part, except for some low hills and **Twin Mountain,** a breached crater 627 feet high.

In clear weather the island generally can be made out for 30 miles from any direction. The island is Inhabited by herds of reindeer.

In 1899 the U.S.S. CORWIN cruised completely around Nunivak Island, following the shore and outlying islands at a distance of about 2 miles, and found general depths of 7 to 10 fathoms. The coast is generally abrnpt and rocky, with numerous bights in which anchorage was found in 3½ to 7 fathoms.

Cape Mohican, the western point of Nunivak Island, is a narrow promontory about 2 miles long. The point of the cape is a cliff 266 feet high from which the terrain descends eastward to 150 feet for 2 miles before ascending gradually to the higher ground inland.

Cape Mohican Light (60°13′ N., 167°27′ W.), 278 feet above the water, is shown from a small white house on the end of the cape. The light is maintained from Angust 1 to November 1.

A shoal about 1 mile wide extends 5 miles 050° from Cape Mohican and has depths of 2 to 4 fathoms over it. The shoal area should be avoided until it has been completely surveyed. The 10-fathom curve extends 7.5 miles 058° from the cape.

Nash Harbor (chart 8851), on the north coast of Nunivak Island 16 miles east of Cape Mohican, is a good anchorage except with winds from northwest throngh north to northeast. The coast to the westward of the harbor is fairly high and is backed by cliffs, while to the northeastward it is low. The south side of the harbor has a sand-and-gravel beach at the foot of a 30-foot bluff. The bottom slopes gradually from 10 fathoms outside Nash Harbor to the beach at the head.

The harbor is 1.5 miles wide and about a mile in depth. The bottom is sand except near the rocky portions of the shore, and there are no indications of dangers over a large 4- to 6-fathom area in midharbor. Boats usually land off the village of **Nash Harbor,** on the west side of a creek that empties into the southwestern part of the harbor; however, there are boulders close to shore at this landing as well as in the cove on the western shore. The creek drains a lake, but the water is brackish because the lake level is affected by the tides. The lake freezes every winter and makes an excellent landing place for airplanes fitted with skis; it is also large enough for seaplanes to use during the summer.

In 1951, the survey ship PATHFINDER made the approach to Nash Harbor on course **090°** for 21 miles from a position 4.5 miles north of Cape Mohican until abeam of the harbor, then steered **180°** for midharbor to anchorage in 6 fathoms.

Cape Etolin (chart 8851), 40 miles east-northeastward of Cape Mohican is the northernmost point of Nunivak Island. The cape is a narrow strip of land with a ridge of low hills midway along its outer part; it appears as two or more islands from a distance westward. A small island is about 2 miles off the end of the cape; between are ledges. A dangerous rocky area extends westward from Cape Etolin for about 1.5 miles.

Mekoryuk (1960 population 242; P.O.), about 2 miles west of the inner end of Cape Etolin, and Nash Harbor are the only villages on Nunivak Island that are inhabited the year round. A weather station is maintained at Mekoryuk, and the village has weekly mail service by air; radiotelegraph communication is maintained with the Alaska Communication System.

In 1951, the PATHFINDER anchored on the west side of Cape Etolin 4.5 miles northwest of Mekoryuk in 5 fathoms, sand bottom, on bearings 080° to north tangent of Cape Etolin, 080½° to highest knoll on Cape Etolin, 122° to center of schoolhouse, the largest building in Mekoryuk, and 246° to north tangent of point 5.5 miles to the southwest. From this anchorage the north tangent of Cape Etolin was open 1½° from the south tangent of Cape Vancouver. The anchorage was approached from westward on a heading of **092°** for the highest knoll on Cape Etolin. The approach should be made with caution as the area shoals rapidly and the reference points are apt to be obscured by fog except during northerly winds. From the anchorage, a launch ran on a general course of **120°** toward Mekoryuk for 3 miles and obtained a minimum depth of 25 feet. It is recommended that ships not approach Mekoryuk closer than the anchorage position until the area has been completely surveyed.

Shoals covered 3 fathoms have been reported about 7.5 miles north and 15.5 miles northwestward from Cape Etolin, and a shoal covered 4½ fathoms has been reported 12.5 miles north-northeast from the cape; all with deep water surrounding them. Keeping Cape Vancouver bearing northward of 086°, Cape Etolin can be rounded when coming from westward in 10 fathoms. With Cape Vanconver bearing 086° or eastward of this bearing, considerable shoal water and irregular depths are found.

Cape Etolin Anchorage (chart 8851), the bight on the east side of the cape, has fair holding ground in 2 to 5 fathoms but is open to the northeast. Near the southerly side, and about 0.3 mile from the head of the bight, is anchorage in 3 fathoms; the holding ground is gravel and only moderately good. Farther out, it is deeper but more exposed to the strong tidal currents and rips of **Etolin Strait,** the wide passage between Nunivak Island and the mainland.

Cape Manning is 15 miles southeastward of Cape Etolin. **Triangle Island** is 5 miles northwest of Cape Manning and 2 miles from the nearest shore of the main island, with foul ground reported between.

Cape Corwin, 20 miles southward of Cape Manning, is the easternmost point of Nunivak Island. The cape is low and has a rocky shore on its north side. The two peaks of Twin Mountain are 7 miles north-northwest of the point of Cape Corwin and can be seen for 25 miles in clear weather.

Cape Mendenhall, 18 miles west-southwestward of Cape Corwin, is the southernmost point of Nunivak Island. The cape is 255 feet high and has a low rock bluff 10 to 20

feet high on its east side. A 2¾-fathom shoal is 4 miles southwestward of Cape Mendenhall.

During a northerly blow in August 1951, the survey ship EXPLORER found satisfactory anchorage in 8½ fathoms about 10 miles northwest of Cape Mendenhall. The anchorage is about 1.5 miles off the beach of the second bight northwest of the cape and is protected from northwest through north to east. As the ship approached on a northeasterly course, the water shoaled uniformly from 14 to 8½ fathoms. The fine gray sand bottom is good holding ground. Currents along the coast had velocities estimated to be as much as 1 knot.

From Cape Mendenhall the coast extends northwestward for about 40 miles to what may be called the southwest cape of Nunivak Island. The few soundings obtained show deep water fairly close to shore, and it is apparently safe to follow the shore at a distance of 2 miles. Depths of 4¾ to 6 fathoms have been found on an extensive shoal about 10 miles off this stretch of coast.

The southwest cape has cliffs 100 to 150 feet high; the summit is gently sloping tundra. In the small cove eastward of the cape, landings can be made on the sandy beach in front of the few barabaras of **Tachikuga,** an abandoned native village. Fresh water can be obtained from the stream just east of the village; at low water the stream is fresh to its mouth. Temporary anchorage is possible in 7 to 9 fathoms about 0.8 mile off the entrance to the cove.

From the southwest cape, the coast of Nunivak Island extends northward for about 8 miles to Cape Mohican. Along this stretch are impassable cliffs 150 to 450 feet high, and there are no landing places. The 6-fathom curve is about 1.3 miles offshore.

Tides.—The diurnal range of tide at Tachikuga, on the southwest side of Nunivak Island, is 4.3 feet. At Nash Harbor, on the north side, the diurnal range is 5.3 feet, and the tide occurs about 1 hour later than at Tachikuga.

Currents.—On the north and southwest sides of Nunivak Island the current has a large diurnal inequality. Northeastward of Cape Mohican a 4-hour series of current observations in July 1951 showed a northeastward current which at strength had a velocity of 1.8 knots. Observations made in June and August 1951 at a location westward of Cape Etolin showed tidal currents setting along the shore in both directions with velocities of about 1 knot at strength of current. On the east side of the island in Etolin Strait it is stated that tidal currents are so strong that the middle portion does not freeze over in winter. For predicted times and velocities of the current off Tachikuga, see the Tidal Current Tables.

Ice.—See Appendix for dates of ice breakup and freeze-up. Navigation is difficult from mid-December to mid-May and usually is suspended from early January to late March.

Charts 9302, 8851.—St. Matthew Island and adjoining islands are 145 miles westward from Nunivak Island. They are rocky, uninhabited islands whose shores are poorly charted except for a small area between Sugarloaf Mountain and Pinnacle Island. St. Matthew Island is a succession of hills and low valleys. During the season of navigation, fog is prevalent in this vicinity. Anchorage can be made with an offshore wind on the north or south sides of the island.

Cape Upright, the eastern point of St. Matthew Island, is high and vertical, and the land in its immediate vicinity is mountainous. A mountain 1,505 feet high is 0.7 mile back of the cape and another mountain 1,280 feet high is 0.9 mile southwest of the cape. Off the cape is a detached rock 25 feet high. Westward of the highland of the cape is a low neck, apparently of sand, and the cape might be easily mistaken for a detached island.

Glory of Russia Cape, the north point of St. Matthew Island, is also high and mountainous. A 1,475-foot peak is about 1.3 miles southward of the cape.

Numerous detached rocks along the shores of St. Matthew Island should not be approached too closely. On the island is an abundance of fresh water in streams and lakes.

Sugarloaf Mountain, 1,380 feet high, is 11.5 miles westward from Cape Upright. From Sugarloaf Mountain the coast trends about 0.8 mile southeastward to the westernmost point of a wide bight extending to Cape Upright. A rock is about 350 yards southward of this point.

Good anchorage may be had, in about 14 fathoms, sheltered from winds between southeast and southwest, in a bight on the eastern side of St. Matthew Island, about 10 miles northwestward of Cape Upright, with Sugarloaf Mountain bearing 220°, and westward of some outlying rocks which show well out of the water and should not be approached closely. Landing is difficult with any swell, as the beach is stony and steep. In 1951, the PATHFINDER anchored frequently in 9 to 10 fathoms, about 3.5 miles west-northwest of Sugarloaf Mountain, with broken bottom and satisfactory holding ground. The PATHFINDER also anchored in about 14 fathoms, with protection from northerly gales, 4 miles east by south of Sugarloaf Mountain.

Sarichef Strait is a 2.5-mile-wide passage between St. Matthew Island and Hall Island. Tidal currents and rips were not found to be strong in 1951. The PATHFINDER obtained a least depth of 10 fathoms in two passages of the strait near the middle, but the records indicated that shoaler depths could be expected.

Hall Island, about 3 miles north of St. Matthew Island, is 1,665 feet high and is rugged on its northeast, north, and west sides; the southeast point is low. **Elephant Rock** is a large detached rock off **Cape Hall,** the northern point of the island, and **Arre Rocks** are several smaller detached rocks off the southwest side of the island. Anchorage is available in 10 fathoms in the bight on the southeast side of the island.

Pinnacle Island, with its spires and needle formations making a striking appearance, rises abruptly from the sea with scarcely a place for a boat landing. The northern end of the island is 8 miles south-southwest of Sugarloaf Mountain. Pinnacle Island is 1.4 miles long, 0.3 mile wide, and rises to 1,250 feet midway of its length.

An unusual submerged ridge extends from the north end of Pinnacle Island in a 021° direction to the shore of St.

Matthew Island. The ridge is about 300 yards wide between the 10-fathom curves. The least depth found in 1951 was 4 fathoms, and there were several depths of 5 fathoms. The best water over the ridge was 9 fathoms 1.6 miles southwest of the point below Sugarloaf Mountain. Tide rips occur along the ridge with fresh winds.

Rocks and islets 55 to 95 feet high are off the southern shore of Pinnacle Island. **Gull Rock,** 93 feet high, lies 0.5 mile west-northwest of the sonthern end of Pinnacle Island.

Tides and currents.—The diurnal range of the tide at St. Matthew Island is 2.1 feet. For predicted times and velocities of the current, see the Tidal Current Tables.

Chart 9302.—St. Lawrence Island is in the northern part of Bering Sea about 120 miles southward of Bering Strait.

The eastern end of this island is usually made by vessels bound into Norton Sound, and in clear weather can be seen from a distance of 30 to 35 miles. From Southeast Cape a ridge of mountains extends in a northerly direction across the island, and another ridge extends in a northerly direction from Apavawook Cape to Northeast Cape. Between these two ridges a deep bight makes in from southward and at its head very low land extends northward across the island. The shore of the eastern end of the island is generally a low sand beach with outlying rocks; the mountain ridges begin 0.5 to 2 miles back from the beach.

Northeast Cape, eastern end of St. Lawrence Island, is low tundra land, with numerous fresh-water lakes. The cape is 2 miles wide to the foot of a mountain which rises abruptly and has a peak 1,435 feet high. This peak can be seen on a clear day for 35 miles or more. At 0.3 and 0.6 mile from the end of the cape are two hummocks 94 and 280 feet high, respectively; the lower hummock is in 63°18′ N., 168°42′ W.

Although the bottom is irregular off the point of the cape, no breakers were noticed while passing it in rough weather. The north shore of St. Lawrence Island, for 10 miles westward of Northeast Cape, is a low sand beach and grassy tundra with numerous fresh-water lakes. Anchorage with shelter from southerly or southeasterly winds can be had along this shore about 2 miles from the beach in 8 to 9 fathoms; the holding ground is not good, the bottom being gravel. At a point on the north shore 6 miles westward of Northeast Cape, breakers extend 1 mile offshore.

From the Northeast Cape the east coast of St. Lawrence Island has a general southerly trend for 4 miles to a point where a 450-foot-high spur from the higher hills reaches to within 0.5 mile of the beach; along this stretch the 6-fathom curve is 0.8 to 1 mile offshore.

The coast then trends south-southwestward for another 4 miles, then curves westward and northward for 5 miles, forming **Apavawook Cape,** which is so rounding that it has no definite point. This entire stretch of coast is a low, narrow strip behind which is a large lagoon. The mountains are about 2 miles inland and about 900 feet high.

Punuk Islands, lying 4 to 5 miles south-southeastward from Apavawook Cape, are a group of three small islands 1.5 miles long; the northeastern end of the group is about 13.2 miles 192° from Northeast Cape. The northernmost and largest island has two marked rocky hummocks, the higher being 100 to 150 feet high; on the southwestern end of the island are the remains of a native village. The southernmost island is an irregular mass of rocks, the highest point about 75 feet above water. Between these islands is a low, sandy islet, which is separated from the other two by narrow channels completely obstructed by ledges, over which the sea breaks. The shores of all the islands are foul, and a ledge extends southward from the southernmost island; a rocky shoal covered 3½ fathoms lies 1.4 miles south of the southernmost island; over 7 fathoms can be carried 2 miles south of the islands. A reef covered 2 to 3 fathoms extends about 0.7 mile north-northwestward of the southernmost island. Vessels should approach these islands with caution.

A reconnaissance survey in 1951 indicated a clear approach to good anchorage in northerly and westerly weather off **Maknik Lagoon,** northwest of Punuk Islands. The anchorage, in 6½ fathoms, is in 63°09′ N., 169°15′ W., about 1.5 miles off the beach. All soundings showed a uniform slope to the 6-fathom curve, where there is a break and a steeper slope to the beach. Maknik Lagoon is actually bebind the low sand barrier beach.

Heavy breakers have been observed in the channel between Punuk Islands and Apavawook Cape; vessels should not attempt to pass through. A depth of 3 fathoms is 1.7 miles northwest of the northernmost and larger island. Several areas with 3½ fathoms are in this passage. From eastward the islands can be approached as close as 1 mile. It is reported that 2.8 miles 220° from Punuk Islands the flood current was observed setting about 024° with a maximum velocity of 1.1 knots.

Southeast Cape is about 5 miles across on its southern face; the eastern point of the cape slopes gradually to the water for 0.3 mile from the highland, and a reef extends about 0.5 mile southeast from the point. The western point is lower and slopes more gradually to the water for 3 miles from the highland, and a reef makes off from the point in a southerly direction for 2 to 3 miles. The bight between these points is very foul and should be avoided.

Kialegak Point, about 5 miles northward of Southeast Cape, is a long sandspit strewn with rocks, extending in an easterly direction from the highland of the coast. There are breakers about 0.8 mile 355° from the end of the cape, and there may be others inside; a reef extends southward from the south side of the sandspit for about 1 mile. The remains of a native village are on the sandspit.

The bight between Cape Kialegak and Apavawook Cape has a uniform slope from 16 fathoms to the 10-fathom curve, where there is a steeper slope to the beach. The 10-fathom curve is about 2 miles off and parallels the shoreline. Good holding ground can be found in most parts of the bight with good anchorage in northerly and westerly weather. Within 3 miles of the Punuk

Islands the holding ground is very poor and is not recommended.

Northwest Cape, the northwestern end of St. Lawrence Island, 660 feet high, is a steep, black bluff and flat on top. A wide sand beach is west of the bluff. **Gambell** (1960 population 358; P.O.) is a native village with a school and a store, open the year round. Small quantities of oil and gasoline are available. A visiting nurse calls at the village periodically. A small airstrip is available. Mail and supplies are flown in weekly from Nome. Radiotelegraph communication is maintained with the Alaska Communication System.

The water is deep close to Northwest Cape, and anchorage can be had in 9 fathoms, rocky bottom, 0.5 mile offshore on either side of the point of the sand beach with Gambell village bearing 225°. In westerly winds, breakers have been observed extending 400 yards northwest from the northwest tip of land lying 3,500 yards west of Northwest Cape. The bay, 6 miles southeast of Northwest Cape, affords anchorage with protection from southerly and westerly winds, in 9 fathoms, rocky bottom, off the house on the beach.

The western end of the island, south of Northwest Cape, is rolling land. From **Tatik Point** around to the bay east of **Southwest Cape** the land is mountainous and abrupt close to the coast, being highest at Southwest Cape. Only a few families live at Southwest Cape.

Several rock pinnacles, the largest of which is 25 feet high, are off the southwest tangent of Southwest Cape on the eastern side of the entrance to Murphy Bay.

Between the highland east of Southwest Cape and **Siknik Cape** the land is low. A vessel reported striking a sunken rock about 2 miles offshore at a point about 16 miles northeastward of Southwest Cape.

A reef, bare at low water, makes off 1 mile in a 220° direction from Siknik Cape. The submerged part of this reef extends about 4 miles in a general 175° direction from the bare part. This reef is dangerous, as the water shoals abruptly when approaching the cape.

The rest of the island is generally high and rolling. There are some sunken rocks in the bight westward of Southeast Cape, and also some detached rocks showing off the north shore near **Kookoolik Point** and **Savoonga Point.** It is probable that with care an anchorage may be found almost anywhere around the island, but the shores must be approached with caution.

Savoonga (1960 population 299; P.O.), at the extreme end of Savoonga Point, has a school and a native store open the year round. Small quantities of gasoline, diesel oil, and motor oil are available. Mail is delivered from Gambell weekly, weather permitting, by boat in summer or dogsled in winter. There is a village nurse. Radiotelegraph communication is maintained with the Alaska Communication System.

A bar extending northeastward from the village breaks at low water. Anchor just westward of the village in 6 fathoms. Good anchorage can also be found about a mile westward and a mile northward of the village in 14 fathoms.

Tides and currents.—The diurnal range of the tide at St. Lawrence Island varies from 1.2 feet at **Niyrakpak Lagoon** entrance, 26 miles westward of Savoonga, to 2.4 feet at Northeast Cape and **Powooiliak Point,** 6 miles northeastward of Southwest Cape.

The current velocity about 0.8 mile off Savoonga is about 1 knot on the flood setting northwestward and 1.5 knots on the ebb setting eastward. The current velocity at other places around St. Lawrence Island is generally less than 1 knot; see Tidal Current Tables for predictions.

Weather.—During the ice-free months of May to November, the diurnal temperature range is only 5° to 10° F. From January through March, the range is 10° to 12° F. In the winter, passing cyclonic storms exert the major control on air temperatures. Mean monthly temperatures at Gambell range from 2.8° F. in January to 49.3° F. in August. Extremes of −28° F. have been recorded in March and 71° F. in July.

Relative humidity at Gambell is high, usually 80 to 90 percent or more. At least a trace of precipitation occurs on 275 to 300 days a year, yet the annual total is only about 15 inches, about half of which falls during July to October, the ice-free months. The greatest rainfall comes with southeasterly winds of cyclonic centers to the south of the island. Snow accumulation is at a maximum of about 2 to 2½ feet in March, and by the first week in June it remains only in drifts, some of which persist through the summer.

During the winter, from October through April, the wind is prevailingly from the north or northeast and averages over 20 miles per hour. The peak recorded velocity was 80 miles per hour in October 1947 and was from the north. During the summer, the wind is more variable, being from the north or northwest about 30 percent of the time and from the southwest or southeast about 40 percent of the time. The mean summer velocity is 12 to 13 miles per hour; the mean maximum is 38 to 40 miles per hour.

Throughout most of the year, and particularly in the summer from May to September, broken to overcast sky conditions prevail. Clear skies are seldom seen more than 2 or 3 days a month. The principal cloud types consist of fog, stratiform, and rarely cumuliform clouds at various levels. Most are generally below 10,000 feet. Low ceilings are most common during the summer. The visibility is over 7 miles for about 70 percent of the period June through September. The best visibility is in September.

See the Appendix for dates of ice breakup and freeze-up. Navigation is difficult from mid-December to late May and is suspended during most of March and April.

Contaminated water.—Ground water and some of the running streams of St. Lawrence Island are dangerously contaminated by parasites from the small rodent known as the **lemming.** If the parasites enter the human body they attack first the kidney and then infect the liver and bone marrow, resulting in a long illness which is fatal. Visitors are warned not to eat fish caught in the streams nor handle the lemming whether dead or alive.

Communications.—Airmail service is available to St. Lawrence Island during the winter when the tundra at

Savoonga and Gambell is frozen. From June to October, seaplane landings can be made on a lake near Gambell but no regular service is maintained.

Ships visit St. Lawrence Island infrequently. An Alaska Steamship Co. freighter calls at Savoonga and Gambell once a year. An Alaska Native Service vessel makes a trip or two each year and one or two visits by Coast Guard cutters can be expected. Local vessels from Nome call occasionally.

Transportation about the island in summer is mostly by native walrus hide boats or whaleboats, which usually are powered by outboard motors mounted inboard in a specially constructed well. Dogsleds are used in winter and summer on tundra, but are not particularly efficient in summer. There are no roads. Trails are unmarked but are readily followed in the areas around Gambell and Savoonga.

Caterpillar tractors are available at Gambell and Savoonga but their use for ordinary transportation is prohibitively expensive. Trains of tractors and go-devils can be used in many parts of the island if heavy transportation is necessary. Weasels have proved their value on snow, on the tundra, and in small lakes; such vehicles can move over most of the island, except on the coarsest boulder fields and the steeper slopes.

Landings can be made on almost any part of St. Lawrence Island during the summer. The surf is not heavy, except where brisk offshore winds pile up the shallow offshore water into large breakers. Supplies for Gambell are landed by whaleboat on both the north and west sides of the spit, depending upon weather and sea conditions. At Savoonga, supplies can only be landed during periods when a north wind is not blowing because of the heavy surf.

Chart 9302.—Cape Vancouver, about 16 miles northeast from Nunivak Island, is a bold promontory, 1,132 feet high. The shoal from the mouth of the Kuskokwim River is thought to extend along the coast to Cape Vancouver, so that on the south side of the cape the water is shoal; about 6 miles westward of the cape a 1.5-mile circular shoal covered 1½ fathoms was reported in 1957. Immediately off the end of the cape is deep water, which extends about 5 miles along the north side of the bight on which the native village of **Tanunak** (1960 population 183) is situated. This bight is a series of mudflats mostly bare at low water. The BEAR anchored in 4½ fathoms about 1 mile off the south point of the bight and reported shoals extending off the mouth of that bight northwestward and **Hazen Bay** to be shallow.

Hooper Bay, the second bay south of Cape Romanzof, appears to offer the best anchorage for moderate-draft vessels in the area between Cape Vancouver and Cape Romanzof. The recommended anchorage is 0.2 mile southeast of the east end of the sandspit, about 2.5 miles southeast of the village of Hooper Bay. The least depth found in the approach to the anchorage was 3½ fathoms on the series of sand ridges that parallel the beach. The anchorage is in 8 fathoms in the channel between the sandspit and a sand bar to the eastward that bares at low water.

Off the end of the sandspit, the channel is about 0.3 mile wide and its axis lies in a northeast-southwest direction. Both sides of the channel are very steep, and depths of as much as 13 fathoms were found close to the spit.

Currents.—See the Tidal Current Tables for predictions for Hooper Bay entrance. There are two floods and two ebbs each day; the flood sets northeastward and the ebb southwestward.

See Appendix for dates of ice breakup and freezeup.

The village of **Hooper Bay** (1960 population 460; P.O.), 62 miles north-northwestward of Cape Vancouver and 17 miles south of Cape Romanzof, is the most prominent feature in the area. It is on the highest ground, and the school and tin-roofed buildings are visible for about 10 miles. To reach the anchorage, steer **075°** for the village until within 2.5 miles of shore, then steer **130°** until abeam of the east end of the sand dunes and within 1.1 miles of shore, then head for the anchorage off the sandspit.

The village can be reached from the anchorage by small boat across the west end of the bay and up the creek along which the village is situated. The entrance to the creek is marked by stakes. The limiting depth is dependent upon the stage of the tide. The entrance to the creek bares at low water, and the entire west end of the bay is very shallow, but there is deeper water inside the creek. Emergency supplies can be obtained from a store. Airmail service is weekly during most of the year; radiotelephone and radiotelegraph communications are maintained with the Alaska Communication System.

Small boats drawing 1 to 4 feet, depending on the season of the year, can travel inland from Hooper Bay to the Yukon River. The route follows the **Keoklivik River,** southerly and larger of the two emptying into Hooper Bay, to a junction with the **Kashunuk River** at the old village of **Chevak** (1960 population 315; P.O.); thence through a cutoff to the **Aphrewn River;** thence up this river, also called the Kashunuk on some charts at this point, and into Driftwood Slough about 5 miles south of the Yukon.

Driftwood Slough has two entrances from the Yukon. The one most used is about 2 miles downriver from **Pilot Station** (1960 population 219; P.O.), which is about 115 miles above the mouth of Apoon Pass. The other entrance is about 12 miles above **Mountain Village** (1960 population 300; P.O.), which in turn is about 85 miles above Apoon Pass. The part of the slough leading from this latter entrance meanders considerably and is little used. At the Yukon, Driftwood Slough is about 250 feet wide and is 1½ to 2 feet deep during the dry season.

Following the ice breakup in the spring, the least depth along the inland route is about 3 feet; by early July it is about 1 to 1½ feet; and by early September, after the rainy season in August, it may be as much as 4 feet. The shallowest part of the passage is about 20 miles southsouthwest of Pilot Station.

This inland passage may also be entered from Bering Sea by way of the Kashunuk River, which empties into the sea between Hooper Bay and Hazen Bay, or from Hazen Bay by way of the Aphrewn River.

Kokechik Bay is the funnel-shaped body of water on

marsh, ponds, and tundra. The only high ground is **Hogback Hill,** a rounded ridge about 300 feet high, 7 miles eastward of the pass and 2 miles back of the coast. A range of hills and mountains 10 to 20 miles back of the coast extends southeastward to the first great bend in the Yukon.

Several private lights and daybeacons, maintained from August 1 to November 1, mark the approach from northeastward and the entrance to Apoon Pass. The channel across the flats is also marked by stakes during the season of navigation. As the depths across the outer flats are only 1 to 2 feet, all but the shallowest draft vessels must cross at or near high water.

The **tide** in Apoon Pass is more or less diurnal; the diurnal range is 4 feet at the mouth of the pass and about 1 foot at the Head of Passes. The tides at the entrance are greatly affected by winds, which may be strong enough to entirely obliterate the natural tides; northerly and easterly winds lower the water level, and southerly and southwesterly winds raise it. The ordinary outflowing **current** in Apoon Pass is much less rapid than that in other passes, but there are a tidal inflow and outflow with velocities that depend upon the particular range of the tide.

Chaniliut (1960 population 93), on the south side a mile above the mouth of Apoon Pass, has a school and radiotelephone service. **Kotlik** (1960 population 57; P.O.) is at the mouth of **Kotlik River,** which empties into the south side of the pass 5 miles above the mouth.

Hamilton (1960 population 35), on the southeast side 22 miles above the mouth of Apoon Pass, is headquarters for the Northern Commercial Co. Gasoline, diesel oil, and supplies can be obtained at the village. Mail service is provided the year round. Radiotelegraph service is maintained with the Alaska Communication System.

Nunachik Pass and **Little Apoon Pass** make off to the westward from Apoon Pass just above Hamilton. Apoon Pass joins Kwikpak Pass 25 miles above the Apoon mouth. **New Fort Hamilton,** on the east bank of Kwikpak Pass, is 40 miles from the Apoon mouth.

Yukon River, one of the largest of the world, is the largest and most important river in Alaska. It is navigable for flat-bottom boats along its entire course from the mouth to near the head of **Lake Bennett.** No one company operates vessels along the entire river. Transfer points are at **Marshall** (1960 population 166; P.O. Fortuna Ledge), 153 miles above Apoon Pass; **Tanana** (1960 population 349; P.O.), 628 miles above Apoon Pass; **Nenana** (1960 population 286; P.O.), 50 miles southwestward of Fairbanks on the Tanana River; and **Dawson,** Canada (1961 population 881; P.O.), 1,197 miles above Apoon Pass. The **Porcupine, Chandalar, Tanana, Koyukuk,** and **Innoko Rivers** are the principal tributaries of the Yukon in Alaska.

Between Tanana and the delta, **Ruby** (1960 population 179; P.O.), 526 miles above Apoon Pass, is the only town located on the south side of the river.

River steamers may ascend to Whitehorse, Yukon Territory, Canada. The White Pass and Yukon Railway connects Skagway, Alaska, and Whitehorse, Canada, the head of river-boat navigation. The Alaska Railroad connects Seward and Fairbanks; the latter is on Chena River. **Chena River** flows into the Tanana River.

Although the Yukon River is navigable all the way from the Bering Sea to Whitehorse, it can neither be entered by oceangoing ships nor navigated by them. The river itself is shallow in many places and, like the Mississippi, is a maze of bars, bayous, and side channels for much of the length. At the river mouth is a vast delta with sand flats reaching far out to sea. Such channels as the currents have made are too shallow for the passage of oceangoing ships and are perpetually shifting. The river boats are built especially for this shallow-water work, as are those used on the Mississippi.

See appendix for dates of ice breakup and freezeup at places on the Yukon River.

The mouth of **Pastolik River,** about 2 miles from the outer end of Apoon Pass, affords anchorage for small vessels. The Apoon flats extend in front of the entrance, and it can only be entered at high tide.

The eastern entrance point of Pastolik River is marked by a private light maintained from August 1 to November 1.

With the exception of the promontory of Point Romanof, the imediate coast is low and flat all the way from Apoon entrance to St. Michael Island. **Point Romanof,** 340 feet high, stands well out about 12 miles westward from the high hills of the coast range. It appears in clear weather like an island in the sea. **Point Romanof Light (63°12′ N., 162°50′ W.),** 25 feet above the water, is shown from a small white house from August 1 to November 1.

After passing Point Romanof, **Crater Mountain,** on the mainland back of St. Michael Island, and St. Michael, Stephens, and Stuart Mountains, on St. Michael and Stuart Islands, appear above the horizon and are excellent landmarks.

An anchorage for medium-sized vessels is in the mouth of the right-hand stream of **Pikmiktalik River,** 8 miles northeastward of Point Romanof. The depth over the bar is about 2½ feet. A shoal extends out from the south point at the entrance.

In moderate weather the ocean swell is not felt between the Apoon entrance and Stephens Pass; but in heavy weather and westerly weather, which is more likely to occur during the latter part of the season, a choppy sea develops and is heavier off Point Romanof than elsewhere. In general, this passage is safe for river steamers in the summer season. During the latter part of the season, however, high winds become more frequent, and the boats are obliged to watch their opportunities.

Anchorages.—Riverboats anchor on the flats or in the channel, wherever exigency demands. In the southern end of St. Michael Canal in the southern branch just above the junction, is a good and safe anchorage in all kinds of weather. The depth is only about 3 feet on the outside bar, and it has to be crossed at high water.

Good protection is available from all but southwesterly weather in 6 to 9 feet in the cove on the south side of Cape Stephens. **Stebbins** (1960 population 158; P.O.), on the

shore of the cove, has a school and a nurse. Radiotelegraph service is maintained with the Alaska Communication System. Mail is delivered from St. Michael and Unalakleet.

Stuart Island, northwest of St. Michael Island, is separated from the latter by **Stephens Pass,** which has a minimum width of about 0.6 mile. The island is divided into two approximately equal parts by a narrow north-south waterway which is used considerably by small launches and native craft. **Stuart Mountain,** 483 feet high, east of the center, is the highest point. The rest of the island is low and rolling, with some small, scattered peaks. The shore of the island is very irregular. From **North Point** to **Observation Point** and around through Stephens Pass is a line of conspicuous bluffs about 170 feet high; the rest of the coast is much lower. From Observation Point to the west point of the island the north shore is free from outlying dangers; 5 fathoms can be carried 1 mile from the beach. Off the west point, some detached rocks extend about 300 yards. On the east face of the island well toward the southeast point a shoal makes out about 3 miles. **Cape Stephens Light (63°33′ N., 162°18′ W.),** 200 feet above the water, is shown from a small white house on the southeast side of Stephens Pass; the light is maintained from August 1 to November 1.

Egg Island, 10 miles eastward of Stuart Island, is small and affords little protection in heavy weather, but it is the only lee to be had in northerly gales. The water off the western shore is deep, 6 fathoms being found close inshore. **Egg Island Light (63°36′ N., 161°43′ W.),** 90 feet above the water, is shown from a small white house on the highest part of the island; the light is maintained from August 1 to November 1.

St. Michael Island, which is separated from the mainland by St. Michael Canal, is mostly low but has two conspicuous rises: **St. Michael Mountain,** 472 feet high, near the center of the island, and sharp conical **Stephens Hill,** 331 feet high, overlooking Cape Stephens and Stephens Pass.

St. Michael Canal is a narrow, crooked tidal slough which forks and comes together again. Distances through the canal are 18 miles by way of the north fork and 20 miles by way of the south fork. The southern fork is generally used because it is wider. Depths in the canal are probably less than the 6 feet of the old improvement project but are sufficient for the traffic of the area; the depth over the bar at the southwestern entrance is about 3 feet. **Canal Point,** on the north side of the southwestern entrance, is marked by a private light maintained from August 1 to November 1. Private buoys maintained from August 1 to November 15 mark the dredged entrance to St. Michael Canal.

Chart 9375.—St. Michael Bay is the harbor on the east side of St. Michael Island. **Orizaba Reef** extends 1.5 miles off **Rock Point,** which is 051° from St. Michael Mountain.

Whale Island, close off the east end of St. Michael Island, is 118 feet high and small; on approaching the harbor its east end is seen as a vertical bluff. **Whale Island Light (63°30′ N., 161°59′ W.),** 45 feet above the water, is shown from a small white house on the east end of the island from August 1 to November 1. The passage between Whale and St. Michael Islands is blocked by rocks, bare at low water. Eastward and northward of the island the water deepens rapidly.

A boulder covered 18 feet is 0.5 mile 064° from Whale Island Light.

Beulah Island, about 0.3 mile northwest from Whale Island, is 50 feet high, small and rounded. It has bold water off its northeast side. Between this and Whale Island the water is shoal.

St. Michael (1960 population 205; P.O.), near the eastern end of St. Michael Island, is about 55 miles from Apoon Pass via Stephens Pass. The village shows little evidence of the days when it was of major importance in the Yukon River traffic. Gone are most of the buildings of the Army post and the warehouses of the trading companies, and the tall masts of the telegraph company; the waterfront is littered with the rotting hulks of the once great river fleet.

The Northern Commercial Co. operates the only remaining trading post at St. Michael and maintains facilities for transfer of freight from ocean to river vessels. The village has a church and a school, but no hospital and no physicians; a traveling nurse from the Bureau of Indian Affairs calls at the school.

Limited amounts of diesel fuel and supplies can be obtained at the trading post. Drinking water is usually hauled to the village by boat. A marine railway operated by the Northern Commercial Co. can handle vessels up to 100 tons and 9 feet in draft, and has limited machine shop facilities.

Radiotelegraph service is maintained with the Alaska Communication System. Mail service and connections with an airline for transportation inland are maintained the year round. The Northern Commercial Co. operates an irregular freight barge service over the reaches of the lower Yukon during the summer; this service connects at Marshall, 153 miles above the Apoon mouth, with the one remaining Alaska Railroad riverboat, which makes two or three trips downriver from Nenana each season.

Anchorage.—The harbor and anchorage for seagoing vessels is an open roadstead exposed to winds from northwest through north to east. Larger vessels anchor in the offing between St. Michael Bay and Egg Island, and in heavy northerly gales shift their anchorage to get a lee under Egg Island or go to sea. Anchorage is found about 0.5 mile southeastward of Whale Island in 3½ to 4 fathoms, bottom dark-blue mud and good holding ground. Care should be taken to avoid the 18-foot boulder.

Good anchorage in 5 fathoms is 3 miles off Whale Island Light on the following bearings: Egg Island 038°, Crater Mountain 205°, Whale Island Light 227°, North Point of Stuart Island 209° (chart 9380). Use 45 fathoms of chain.

Light-draft vessels and river steamers can find shelter from northerly and westerly winds by anchoring near the east side of the island, in 3 to 8 feet. The shores of St. Michael Bay are strewn with loose rocks, which are often

frozen in the ice in winter and dropped as it goes out in the spring. Light-draft vessels, when anchoring in shoal water, should be careful not to anchor over any of these loose, scattered rocks.

Tides.—The tides of St. Michael are chiefly diurnal, the range being 3.9 feet. Daily predictions are given in the Tide Tables.

Currents.—About 0.8 mile offshore in St. Michael Bay, the current velocity is about 0.8 knot. Like the tide itself, the tidal current is chiefly diurnal and sets southeastward on the flood and northward on the ebb.

See appendix for dates of ice breakup and freezeup at St. Michael.

St. Michael being the end of deep-water navigation, all the Yukon traffic beyond this point has to be conducted with vessels drawing 5 feet or less. The larger launches leaving St. Michael Bay go around the north side of St. Michael Island and through Stephens Pass, between St. Michael and Stuart Islands. They give the reef off Rock Point, on the north side of St. Michael Island, a wide berth, and after passing between the islands a straight course is made slightly westward of Point Romanof. When the summit of Point Romanof is abeam, about 1.5 miles, the direction is changed and a course is steered for Apoon Pass. The most dangerous part of the passage is the 14 miles around the north end of St. Michael Island, which is exposed to the deep-water swell from the north. This can be avoided by small craft by going through St. Michael Canal.

Routes for small craft between Isanotski Strait (False Pass) (55°05′ N., 163°30′ W.) and St. Michael (chart 9302).—After passing out of Isanotski Strait, clear of the outlying breakers, the course is shaped for the east side of Amak Island. Shelter can be found on the south, southeast, and east sides of the island.

Leaving Amak Island, the next course is laid for Cape Newenham. Shelter can be obtained on either side, according to the wind. From Cape Newenham the course is laid for Nunivak Island. If heavy northerly or northeasterly winds are encountered before the island is reached, shelter is sought in the depth of the bight on the south side. Weather conditions being good, it is only necessary to touch at this island if needing water. The anchorage on the north side, about 12 miles eastward of Cape Etolin, is considered the best; see Nunivak Island, earlier in this chapter.

From the northern end of Nunivak Island the customary course is to cross over diagonally to a little north of Hazen Bay, and then coast along just outside the shoals, in 3 to 5 fathoms of water until Cape Romanzof is reached. If the weather is unfavorable or water is required, an anchorage in Scammon Bay is made close inshore on the south side, in a bight where a stream empties.

After leaving Scammon Bay, by giving the spit on the north side of the entrance a good berth, the remaining distance to St. Michael is made by skirting along on the outer portion of the Yukon Flats, in 2 to 5 fathoms, where the courses are exclusively guided by sounding. On this ooked stretch, after the mountains of Cape Romanzof and the Kusilvak Mountains disappear, no land will be visible until the high peaks on the mainland south from Stuart Island are sighted; a little later the summits of Stuart and St. Michael Islands become visible. After Stuart and St. Michael Islands become defined, the course is shaped to go through the pass between them, and then skirt around the north side of St. Michael Island to St. Michael.

In the summer, northerly and easterly winds prevail a large portion of the time between Cape Newenham and Cape Romanzof. The tidal currents in Etolin Strait are strong and at times cause heavy tide rips.

Chart 9380.—The coast from St. Michael Bay to Cape Darby is generally low and rock strewn, and the depths when approaching it shoal gradually from 6 fathoms toward the beach; a depth of 3 fathoms can be taken as close as 0.8 mile except in a few places. There are no outlying dangers, but a reef makes off about 0.5 mile from the shore 2 miles southward of **Black Point,** about 26 miles eastward from St. Michael. **Tolstoi Point** and its vicinity are high and rocky, and from there to Unalakleet River the shore is low.

Anchorage with good protection from southerly winds can be found in **Kiliktarik Bay,** 15 miles eastward of St. Michael. There are several native campsites along this coast but the only permanent settlement is Unalakleet.

Unalakleet (63°53′ N., 160°47′ W.) (1960 population 574; P.O.), at the east end of Norton Sound, is the largest village on the sound east of Nome. An Alaska Native Service nurse is stationed in the village, which also has a mission church, a school, and a store. Vessels can obtain supplies in limited amounts. Radiotelephone and radiotelegraph services are maintained with the Alaska Communication System. Air service for passengers and mail is available the year round from Anchorage.

A shoal extends about 1.5 miles offshore from the mouth of the **Unalakleet River.** The approach to the river is navigable only by shallow-draft boats. During the navigation season, from August 1 to November 15, a light on the south side of the entrance and buoys mark the approach. An aero light is about 0.5 mile north of the entrance. The Unalakleet aero radio range has been found valuable as an aid to surface navigation. Vessels have anchored in 5 fathoms with 60 fathoms of chain about 2 miles offshore. An alternate anchorage is about 6 miles north of Unalakleet.

In winter, prevailing winds are strong from the east and velocities of more than 40 knots are common.

See appendix for dates of ice breakup and freezeup.

Besboro Island is 1,040 feet high and very prominent; on a clear day it can be seen from St. Michael. It affords a poor lee, as the wind draws all around the island. A shoal covered 4 to 4¾ fathoms makes off 2 miles in a northeasterly direction from the north end of the island. The western side of the island is bold-to, and the eastern side can be approached as close as 0.5 mile, with a depth of over 5 fathoms.

Shaktolik River Entrance Light (64°23′ N., 161°14′ W.), 14 feet above the water, is shown from a white

square daymark on a skeleton tower from August 1 to November 1 on end of spit at the entrance to **Shaktolik River,** 7.5 miles eastward of Cape Denbigh.

Shaktolik (1960 population 187; P.O.) is 4 miles southward of Shaktolik River entrance. Vessels can anchor 4 miles off the village in 7 fathoms, mud bottom. Small boats can land at the gradually shoaling shale beach in front of the school, but the approach is extremely shallow and should be made with caution; westerly winds cause considerable surf. Mail is delivered by air from Unalakleet. Radiotelegraph service is maintained with the Alaska Communication System.

Cape Denbigh is a moderately high rounded hill, joined to the mainland by a low narrow neck. The head of the bight, eastward of the cape, is shoal, but in approaching the water shoals gradually. A good anchorage in northeasterly winds can be had eastward of the cape in depths suitable to the draft of the vessel. The south end of the cape is bold-to, and its western side, 2.5 miles northward of the point, can be approached close-to in 4 fathoms. The water shoals rapidly inside a depth of four fathoms when approaching the shore.

Norton Bay is generally shoal. About midway between **Point Dexter** and **Bald Head** is a depth of about 6 fathoms, and from this depth the water shoals gradually as the shores are approached in any direction inside of Bald Head. In some places the 6-foot curve is 5 miles or more from the beach. The north shore of the bay for 15 miles westward of Bald Head is comparatively low, and the water is shoal for some distance from the shore. From a point 15 miles west of Bald Head to Cape Darby the land is high and wooded along the coast; a few native villages are located on this stretch. For 20 miles northeastward from Cape Darby, a depth of 4 fathoms can be taken 0.3 mile from the shore, and in some places much closer. The water shoals gradually on approaching the coast, but the south and east sides of Cape Darby have deep water close-to. During strong northerly winds the water is lowered considerably in Norton Bay.

At **Moses Point** (P.O.), on the northwestern side of Norton Bay, food and water can be obtained and medical facilities are available. There are an aero light and radio range near the village. Radiotelephone and radiotelegraph services are maintained with the Alaska Communication System. Biweekly plane service is maintained with Anchorage.

Anchorage with hard bottom, good holding ground, is off the native village of **Elim** (1960 population 145; P.O.) about 7 miles southwest of Moses Point, in 4½ fathoms; use 60 fathoms of chain. The landing area is at **Iron Creek,** 3.5 miles northeastward of Elim. Mail is delivered by air several times a week. Protection from easterly winds is found in the lee of **Reindeer Hills.**

See appendix for dates of ice breakup and freezeup.

The entrance to **Koyuk River,** flowing into the northeast end of Norton Bay, is marked by buoys from August 1 to November 15.

Cape Darby is the southern extremity of **Kwiktalik Mountain.** The cape is high and rounded terminating at the water in steep rocky bluffs. **Cape Darby Light (64° 20′ N., 162°48′ W.),** 105 feet above the water, is shown from a small white house on the west side of the cape from August 1 to November 1.

Rocky Point is a high bold promontory with irregular rocky cliffs. **Rocky Point Light (64°24′ N., 163°09′ W.),** 175 feet above the water, is shown from a small white house at the western entrance to Golovnin Bay from August 1 to November 1.

Chart 9382.—Golovnin Bay, on the north side of Norton Sound, has its entrance between Cape Darby and Rocky Point, with a width of 10 miles. It extends in a general northerly direction for 12 miles to the entrance to Golovnin Lagoon. The east shore is high and bold, with occasional sand and gravel beaches.

Carolyn Island, low and rocky, lies 0.2 mile off the east shore, about 8 miles north of Cape Darby. **Carolyn Island Light (64°27′ N., 162°53′ W.),** 40 feet above the water, is shown from a small white house on the south end of the island from August 1 to November 1.

The west shore of Golovnin Bay for about 3 miles north of Rocky Point is high and bold, but beyond this is a low sand beach with a prominent point about 5 miles north of Rocky Point. The head of the bay on the west side of the entrance to Golovnin Lagoon lies between a sandspit projecting from the eastern shore and a low sand island extending northward from the west shore and connected with it at low water.

The tidal current in Golovnin Bay is chiefly diurnal. The current velocity is about 0.5 knot off Carolyn Island; floods northward and ebbs southward.

Deep water can be carried close under Cape Darby and Rocky Point. Eastward of Rocky Point is an extensive middle ground on which the least depth found was 23 feet; on its east edge it rises abruptly from 36 to 42 feet. With the exception of this middle ground, the bay is free from dangers south of the low point on the west shore, the deepest water being on the east side, and ranging from 66 feet close under Cape Darby to 24 feet 0.5 mile northwest of Carolyn Island. In the south part of the bay the high land may be approached closely, but off the low land the 18-foot curve is in places nearly 1 mile offshore.

In 1952 the Bureau of Indian Affairs ship NORTH STAR reported striking a submerged object in 64°20′ N., 163°06′ W., about 4 miles south-southeast of Rocky Point; the vessel was drawing about 21 feet.

In the north part of the bay an extensive shoal, with 4 to 8 feet, makes out in a northeast direction from the west shore to within 0.8 mile of the east shore, its extremity lying about 2 miles 093° from the north point of South Spit on the south side of the entrance to Golovnin Lagoon. The channel leading to the entrance to Golovnin Lagoon lies on the eastern side of the bay, passing around the east end of the shoal and following the eastern shore at a distance of 0.4 to 0.7 mile, with an average width of 800 yards. The least depth in the channel is 13 feet, but 15 feet has been taken in at high water. The diurnal range of the tide is 1.8 feet, but this is influenced by the prevailing winds which have a tendency to bank up the

water in heavy southerly weather and to lower it with northerly and northeasterly winds.

Golovnin Bay Light (64°31′ N., 162°55′ W.), 40 feet above the water, is shown from a small white house on the northeasterly shore of the bay from August 1 to November 1. Buoys mark the channel in Golovnin Bay from August 1 to November 1.

South Spit Light, on the north end of **South Spit,** about 1 mile south of Golovin, and **Cheenik Light,** on the end of the spit west of Golovin, mark the entrance to Golovnin Lagoon; both lights are maintained from August 1 to November 1.

Anchorage.—A little westward of South Spit, in the entrance to Golovnin Lagoon, anchorage may be had in 36 to 42 feet, with protection from all winds. For vessels whose size prevents the use of this anchorage, the best is off the point on the west side of the bay in about 24 feet. This is unsafe in southerly weather, but is the most convenient for communicating with the head of the bay. By shifting anchorage from one side to the other in Golovnin Bay good shelter is found from easterly or southwest or westerly winds.

An anchorage with good holding ground in 42 feet is located on the following bearings: Rocky Point Light 253°, Cape Darby Light 153°, Carolyn Island Light 040°, and Golovnin Bay Light 000°. Use 60 fathoms of chain. Keep at least 1 mile south of Carolyn Island.

Golovin (1960 population 59), on the north spit at the entrance to Golovnin Lagoon, is a distributing point for the mining district of the Fish River country. The village has a school, roadhouse, cold-storage plant, two salteries, several stores, and an airport. Radiotelegraph service is maintained with the Alaska Communication System.

Golovnin Lagoon is very shallow and is navigable for small vessels of 3½ feet draft to the mouth of the **Fish River,** which empties into the head of the lagoon. The channel through the lagoon is narrow and tortuous. **White Mountain** (1960 population 151; P.O.), on Fish River, is a fishing village with a school and a store. Radiotelegraph communication is maintained with the Alaska Communication System.

See appendix for dates of ice breakup and freezeup.

Chart 9380.—For about 22 miles, from Rocky Point to Topkok Head, the land is high and bold, in many places rising abruptly. Beyond this to Cape Nome the coast is low, with high land farther back. Immediately behind this lowland is a large shoal lagoon with two small entrances, the west one called Port Safety. Between Rocky Point and Cape Nome the water is deep, the bottom regular, and by giving the shore a berth of 1 mile a depth of 6 fathoms or more will be found.

Topkok Head is 22 miles westward of Rocky Point, and is the first highland close to the coast eastward of Cape Nome. Its seaward face rises abruptly from the water 586 feet and is a well-known and conspicuous landmark.

A yellow bluff, 572 feet high, on the east side of **Bluff,** about 6 miles eastward of Topkok Head, is conspicuous, but not as much so as Topkok Head.

Solomon is a mining village at the mouth of **Solomon River,** 11 miles westward of Topkok Head and 17 miles eastward of Cape Nome. A railroad has been built up Solomon River to **Council.** Solomon has a store and roadhouse. It is the coast terminus and shipping point for Council. The depth on the bar at the entrance and inside Solomon River is about 3 feet, but local knowledge is necessary to keep in the best water. A fuel oil tank is a good landmark. No lights are visible on shore from the anchorage.

An anchorage approximately 2 miles offshore in 8½ fathoms, hard gravel and sand bottom, is located on the following bearings: Cape Nome 254°, largest house in village 358°, Topkok Head 079°. Use 45 fathoms of chain. The only protection against heavy winds is to stand out to seaward.

See appendix for dates of ice breakup and freezeup.

Chart 9381.—Port Safety, about 8 miles eastward of Cape Nome, is a small anchorage for vessels of less than 7-foot draft. The channel is narrow and has a depth of 7 feet. Small vessels can anchor in the narrow sloughs which lead between the flats inside the entrance.

Chart 9380.—Cape Nome is a bluff, about 300 feet high, 1 mile broad, and rounded down to the water on either side, where the land at the shore is low, with higher land farther back. The water off this cape is quite deep. The diurnal range of tide at Cape Nome is about 2 feet.

From Cape Nome to Cape Rodney the coast, except abreast of Sledge Island, is a comparatively straight stretch of low sand beach, with no projecting points, and higher land some distance back. Abreast of Sledge Island for a distance of several miles the hills slope down to the beach, giving this part of the coast the appearance of a point. The stretch of beach is broken by a number of small rivers, where mining is in progress. The entrances to **Nome,** Snake, **Penny,** and **Sinuk Rivers** have shifting bars, but there is generally enough water in the channel over these bars to permit boats of 3-foot draft to enter. When approaching the coast between Cape Nome and Sledge Island, the water shoals regularly and gradually until a depth of 5 fathoms is reached; inside this depth the bottom is irregular, especially near the mouths of the rivers.

Chart 9383.—Nome (1960 population 2,316; P.O.), the metropolis of northwestern Alaska, is on the beach at the mouth of the **Snake River,** 11 miles westward of Cape Nome. The harbor is a shallow, open roadstead. Large vessels anchor and the passengers and cargo are taken ashore in lighters. Traffic using the dredged channel is handled over the revetment, where transfer facilities that are open to the public use are available.

Considerable hydraulic gold mining is carried on in the country back of Nome, but the placer mining for which the Nome beach was famous has largely been abandoned.

Jetties with lights on the outer ends protect the entrance to Snake River; range lights mark the entrance channel. The lights are maintained from August 1 to November 1. An aero radio range is 2.5 miles eastward of Nome. An 8-foot dredged channel leads to a turning basin at Nome, 0.3 mile above the mouth of Snake River. The turning basin slopes from 8 feet at the southern end to 4 feet at the northern end. Rapid shoaling occurs at the entrance to the channel, requiring maintenance dredging during the open season. With heavy surf, boats crossing the bar before entering between the jetties will ground and are liable to overturn.

The general anchorage for deep-draft vessels is in 7 to 8 fathoms about 1 mile from the beach abreast of Nome. Vessels of less draft anchor in about 6 fathoms a little closer to the beach. In strong southerly winds vessels should anchor farther offshore.

Tides.—The diurnal range of the tide is 1.6 feet. The water levels are influenced more by the wind than tide, an offshore wind sometimes causing a level of from 2 to 3 feet below mean lower low water for days at a time and a level of 14 feet above mean lower low water having been noted as a result of storms.

Currents.—About 2 miles offshore in Nome roadstead the tidal current averages about 1 knot at times of strength. It is chiefly diurnal. The flood sets eastward and the ebb northwestward.

Weather.—Prevailing winds are from the southwest in the summer and from the northeast in the winter. Gales come from all quadrants. The fogs are most frequent in June and July.

See appendix for **Nome climatological table.**

Navigation is difficult due to ice from early December to early June and is usually suspended from late December to mid-May. See appendix for dates of ice breakup and freezeup.

Quarantine.—The United States Public Health Service maintains an outpatient office at the hospital in Nome.

Supplies.—Fresh water and some provisions can be obtained. Diesel oil is not available in large quantities.

Communications.—Nome maintains radiotelephone and radiotelegraph communications with other parts of Alaska and the world. Air service for passengers, mail, and freight is available the year round. Steamship service is available during the summer. From Nome a tramway extends 100 miles to Taylor.

Chart 9380.—Sledge Island, 31 miles west of Cape Nome and 4.5 miles offshore, is a rocky flat-topped island except near the southern extremity where the highest point, a 760-foot jagged mountain, exists. Ruins of abandoned habitations are located on the sandspit on the northern end of the island and along the beach about midway of the eastern side. These are probably ruins of the former village of **Aziak.** Except for the sandspit, the shores of the island are rocky and steep.

Sledge Island Light (64°30′ N., 166°11′ W.), 28 feet above the water, is shown from a small white house on the north point of the island from August 1 to November 1.

The island may be safely approached from any direction except the east, where the exposed wreck of a cargo ship is aground on a rock 1.1 miles east of the light. The area adjacent to the wreck is dangerous to approach because of submerged portions of the vessel which have been carried away by action of waves and ice. Small vessels seeking shelter close in on the north side are cautioned to stay clear of the submerged bar making off northwesterly from the spit. A depth of 6½ fathoms is about 3.7 miles offshore and about 7.5 miles eastward of Sledge Island. The passage between Sledge Island and the mainland has irregular bottom but has depths of 5 fathoms or more. Tide rips have been observed in the passage and on the east side of the island during heavy weather.

With heavy southerly winds, vessels at anchor in the Nome roadstead usually seek shelter behind Sledge Island.

Current observations were made in the passage between Sledge Island and the mainland for a period of 6 days in July 1950. The tidal current is diurnal with average velocity at strength of northwestward current of 1 knot and average velocity at strength of southeastward current of 0.5 knot. Maximum velocity observed during the period of the observations was about 1.5 knots setting northwestward. For predicted currents, see the Tidal Current Tables. Vessels when in this vicinity should give special attention to the currents. Above Cape Rodney there is no perceptible current southward or eastward; the general set is northward and westward.

From **Cape Rodney** to **Cape Douglas** the shore is a low sand beach, and the high land is farther inland from the beach than eastward of Cape Rodney. This coast is seldom approached close-to; the water is comparatively shallow and dangerous shoals and ledges are found between Cape Douglas and Point Spencer.

Vessels are cautioned to exercise care when approaching the shore south of Cape Rodney and to give the shore off Cape Douglas a berth of at least 15 miles; an irregular bottom with depths of 6 fathoms has been found by reconnaissance lines off this cape with indications of lesser depths inshore. From a point about 8 miles north of Cape Douglas the area to the northward, covering the approaches to Port Clarence, has been surveyed.

Cape Rodney Light (64°40′ N., 166°24′ W.), 15 feet above the water, is shown from a white house on the point from August 1 to November 1.

King Island, 1,196 feet high, is about 33 miles west of Cape Douglas. It is about 2 miles square, is rugged and rocky, and has nearly perpendicular cliffs, deep water, and generally rocky bottom on all sides. **Ukivok** is a native village on the south side, the houses being built in the sides of the cliffs some distance above the water. Off the village, but close inshore, vessels may anchor in about 15 fathoms, muddy bottom, with good protection from northwest winds. In clear weather the island is an excellent landfall for vessels coming from southward and bound to Port Clarence.

Cape York is a high, rocky nearly vertical cliff, with numerous ravines and a range of high rugged mountains immediately back of it. The cliff is about 10 to 12 miles in extent. There is no distinct promontory and no

exact point along the cliff that can be defined as the cape.

The area from Cape York to Port Clarence has been surveyed with no depth less than 6 fathoms being found 1.5 miles from the shore. The general depths fall off to a submarine valley about 2 miles offshore, extending eastward, with depths of not less than 10 fathoms, to within 6 miles of the entrance to Port Clarence. A rock is reported about 0.8 mile from the shore southeastward of **York** village.

Between Cape York and the high land of Cape Prince of Wales is a bight, with comparatively low rolling land back of it, extending across the peninsula to the northern shore. The beach is low and the water shoals gradually when approaching the shore. The eastern part of the bight is slightly shoaler than the western part; about 6 fathoms will he found 1 mile offshore; in the western part of the bight 8 fathoms will be found at the same distance from the beach. When standing westward alongshore, and when abreast of Cape Mountain, the water deepens suddenly to 20 fathoms.

Chart 9369.—Port Clarence, a large bay indenting the Seward Peninsula about 35 miles southeastward of Cape Prince of Wales, provides the only good harbor close to Bering Strait. The bay is formed by a low sandspit which extends from the mainland in a northerly direction for about 10 miles to Point Spencer. The highest elevation on the spit is a round knoll near the southern end, 24 feet above sea level. This knoll is inconspicuous except at close range. Near Point Spencer, at the broad portion of the spit, are numerous buildings of an abandoned air station, the most prominent of which is a control tower visible offshore for about 10 miles. Except for the light at **Point Spencer,** maintained from August 1 to November 1, there are no conspicuous landmarks other than these to aid the navigator in making the entrance into Port Clarence.

The channel between Point Spencer and **Point Jackson** on the north shore is 4 miles wide, free of dangers, and with depths of 42 to 48 feet. The northern half of the bay has a general depth of 42 feet as close as 1 mile from shore. There are no dangers, and depths shoal gradually to the beach. The southern half of the bay shoals gradually to the bars and flats along the low shoreline at the south end. Along the western side of the bay the sandspit may be approached fairly close except for the shoal 2 miles south of Point Spencer which makes into the bay from the spit with depths of 15 feet 1 mile off. To the eastward the water shoals to the entrance to **Grantley Harbor,** which is connected with Port Clarence by a narrow channel marked by a light on the north side of the entrance and buoys shifted in position to mark the changeable channel; the aids are maintained from August 1 to November 1. The controlling depth in the channel is not more than 10 feet. The current is strong with many eddies and tide rips.

Anchorage with good holding ground is available anywhere in Port Clarence. Shallow-draft vessels will find greater protection in Grantley Harbor.

Routes.—In approaching Port Clarence from the south in fog or misty weather, the low sand and shingle spit forming the west side of Port Clarence is not visible until close-to. The best procedure is to make a landfall on King Island from the eastward keeping in depths greater than 60 feet to avoid the foul ground northward from Cape Rodney. From King Island a course may be set a little eastward of Cape York to within 3 miles of the coast, thence on course **096°** through the entrance into Port Clarence, where good anchorage may be obtained.

Tides.—The diurnal range of the tide at Port Clarence is 1.4 feet. This condition, however, is subject to radical changes due to meteorological conditions. Moderate to strong southerly or southwesterly winds of several days' duration will raise the height of the tide in the area without appreciably increasing the range. This is actually a datum change and is appreciable along the entire south coast of the Seward Peninsula. It is reported that continued strong northerly winds produce a lowered datum but to a lesser extent.

Currents.—Along the outside coast west of Point Spencer and south of Cape York there is a general westerly set of 1 to 2 knots. This velocity is appreciably affected by direction, force, and duration of the wind.

Current observations in the entrance to Port Clarence indicate that the velocity seldom exceeds 0.5 knot 2 to 3 miles north of Point Spencer. One mile east of the point, velocities up to 1 knot were observed, the larger velocities generally setting westward or northward.

Weather.—The weather, in general, is better than in the Aleutian Island area, with less fog and fewer bad storms during the short summer navigation season. Fog and high winds are generally of short duration so that it is seldom that planes cannot land at Teller at least once a week. The winter weather is generally better than the summer for plane service, as there is little or no fog during cold weather.

The first surface fog appears after the spring break-up and is of an intermittent character, generally local, and forming and disappearing at intervals as short as one-half hour. As the season advances, the fog is more prevalent, of greater density and longer duration, but in general it offers no serious obstacle to surface navigation.

See appendix for dates of ice breakup and freezeup.

Teller Mission (1960 population 77) is on the north shore of Point Clarence 9.5 miles northeastward of Point Spencer.

Teller (1960 population 217; P.O.), 12 miles east of Point Spencer is on the base of the southern spit at the entrance to Grantley Harbor. There is a school and a mission, with two general merchandise stores and a suboffice and warehouse of a commercial company at Teller. An unsurfaced landing strip, about 1,000 feet long, lies in a north-south direction along the spit north of the town; a shorter, grass-covered strip lies across the base of the spit south of the town. The latter strip is used only when cross winds prevent landing on the main strip. Mail is delivered by air from Nome.

Wharves.—Two ramp-type docks furnish facilities for unloading supplies from lighters and shallow-draft vessels

on the Grantley Harbor side. Freighters must anchor well offshore in Port Clarence and lighter cargo to Teller.

Supplies.—Food, coal, diesel oil, lubricating oil, and gasoline may be obtained in limited quantities from the two stores. Loading of oils and gasoline is by drum only. There is no connection for obtaining fresh water. Shallow-draft vessels may obtain water through a hose at the mouth of **Fox Creek,** 3 miles south of **Cape Riley.** Larger craft may anchor 0.7 mile offshore in 25 to 30 feet and boat fresh water from the beach.

Communications.—Radiotelephone and radiotelegraph services are maintained with the Alaska Communication System. Passenger and light freight service is principally by plane, but occasionally freighters and tugs with lighters furnish transportation for heavier supplies during the short navigation season.

Imuruk Basin (chart 9380) is a shallow body of water eastward of Grantley Harbor; the two are connected by narrow, difficult **Tuksuk Channel.**

Kuzitrin River rises in the Seward Peninsula and flows in a westerly direction about 75 miles to Imuruk Basin. The anchorage for oceangoing vessels is in Port Clarence, the head of navigation for powerboats and other vessels up to 12 feet in draft is the mouth of Kuzitrin River. Shallow-draft lighters can navigate the Kuzitrin for about 15 miles to **Shelton.** The river is open from June to October.

9. ARCTIC OCEAN

Chart 9400.—Bering Strait, 44 miles wide between Cape Prince of Wales, Alaska, and Cape Dezhneva, Siberia, is the gateway from Bering Sea in the Pacific Ocean to **Chukchi Sea** in the **Arctic Ocean.** The northern limit of Chukchi Sea is a line from Point Barrow, Alaska to the northernmost point of Wrangel Island, Siberia.

The Arctic coast of Alaska has a general length of 921 nautical miles and is mostly low; tidal shoreline totals 2,191 miles. The lowlands have their greatest depth in the wide triangular plain with its apex near Barrow and its base against the **Brooks Range,** 150 miles to the southward. The western end of Brooks Range is near Cape Lisburne and the eastern end is near Demarcation Point; actually it is not one but a series of ranges, some reaching elevations of more than 8,000 feet.

Most of the coastal plain is low, rolling tundra cut by numerous streams and lakes. The **tundra** is a cover of grasses, lichens, and shrubs which, for a short time during the summer, is brightened by flowers; during the rest of the year it presents a dreary aspect. Tundra is poorly drained and most of it is permanently frozen below the surface; this permanently frozen ground is known as **permafrost.** During the summer, the tundra thaws to a depth of a foot or more but is kept moist because water cannot penetrate the permafrost.

The **frost mounds** seen occasionally along the coast are produced by frost action on the tundra and very widely in size and duration. A large frost mound is known as a **pingo** and may reach a height of 300 feet; the summit is usually fissured and may emit drinkable water. **Frost blisters** usually form along sloping ground and may shift in position from year to year; they seldom exceed 25 feet in height.

The native **sod houses** stand 6 to 10 feet above the ground and are built of logs with sod piled around the walls and on the roof. They can be distinguished from frost mounds by the steepness of their sides and the smoke pipe that usually projects from the center of the roof.

There are few harbors, port facilities, or aids to navigation along the Arctic coast. Depths near shore may change as much as 6 feet because of ice gouging; storms also shift the sands in shallow water but there is little evidence of such shifts in the deeper water. **Abnormal refraction** is a common occurrence; a pingo may loom like a mountain, and landmarks may be sighted much farther from shore than the normal limit of visibility.

Currents.—Observations totaling about 6 days were made in Bering Strait off Cape Prince of Wales during the summer of 1950. When not opposed by northerly winds, the current flowed northward with velocities that sometimes exceeded 2.5 knots.

From Bering Strait to Point Barrow the current sets northward along the shore and has a velocity of not less than 1 knot when not opposed by winds or stopped by ice. A current from Kotzebue Sound joins the current from Bering Strait north of Cape Krusenstern and the resultant velocity in July and August is 1.5 to 2 knots as far as Point Hope. After rounding Point Hope the velocity decreases to about 1 knot.

Northward of Point Lay the current is stopped if the ice has not opened up from the shore; if the ice is open to Point Barrow, the current continues along the shore but, because of the constricted space between shore and ice, increases in velocity to 2 or 3 knots at Point Barrow. The general current is affected by the winds and may be decreased or even stopped by northerly winds, but when such winds abate the current resumes; when the wind is with the current the velocity is increased. Well offshore, the currents are variable and not so strong; they are influenced considerably by the winds but there is a definite general set northward. Eastward of Point Barrow the currents are irregular and unpredictable but seem to be caused mostly by winds and moving ice.

Weather.—At most places along the Arctic coast there is a prevalence of north through east winds from October through March and at a few places from September through May. The summer winds are more variable, with directions from northeast or southwest being most frequent. In and near Kotzebue Sound easterly winds prevail from September through April and westerly winds through the remainder of the year. During winter months the north coast normally experiences higher winds than other parts of Alaska; winter winds of 50 to 55 knots are not uncommon, and winds of better than 65 knots have been experienced at Barter Island. These strong and rather persistent Arctic winds tend to parallel the coast from Barrow to Barter Island.

Precipitation over the area is very light, ranging from an annual average of 4 inches at Barrow to 8 inches at Kotzebue. Somewhat more than half of the precipitation falls in the form of snow. Annual snowfall is 27 inches at Barrow, 41 inches at Kotzebue, and 46 inches at Barter Island.

Mean annual temperatures are 10° F. at Barrow, 11° F. at Barter Island, and 21° F. at Kotzebue. The highest temperatures of record are 78° F. at Barrow, 72° F. at Barter Island, and 85° F. at Kotzebue. The higher temperatures occur infrequently, however, since the average of the daily maximum temperatures is below 50° in all

months of the year at Barrow and Barter Island and in all except July and August at Kotzebue. The extreme low temperatures are —56° at Barrow, —59° at Barter Island, and —48° at Kotzebue.

Heavy fog is reported on an average of 65 days a year at Barrow, 74 days at Barter Island, and only 21 days at Kotzebue; maximum fogginess occurs during the summer. Thunderstorms are rare, although they have been reported a few times in summer at Barrow.

Ice.—Unless there is an unusually late spring, the ice begins to break in Bering Strait and Kotzebue Sound by early June. Heavy drift ice from Kotzebue Sound is often found between Cape Blossom and Point Hope in late June.

At Point Hope and Cape Lisburne, the pack ice breaks off from the shore ice in May and moves off and closes in again with changing winds, gradually working off to the northward and westward. Young ice forms in the spaces thus left but gradually gets thinner until it disappears in June.

From Cape Beaufort to Point Barrow the pack moves gradually north, clearing from point to point. A shift of the wind to westward brings the pack in on shore when a few hours before it was out of sight from the land.

At Point Barrow, the pack breaks off from the flaw or shore ice in the spring and moves off and on until June. When the pack moves off in June, it begins to take a northwest movement and continues to do so until it is out of sight. The movement of the pack, on and off, continues well into July, after which time heavily massed floe ice, much broken and heavily jammed together, may be expected. The shore ice leaves the beach late in July but remains in sight until the middle of August, or perhaps all summer. In exceptional seasons the pack remains on the point the year around. Eastward of Point Barrow, ice conditions are very uncertain. When the pack ice moves offshore it does not go very far, and the shore and drift ice extend well inshore from its edge. The current along the west shore of Alaska sets northeast from Point Barrow; the movements of the ice to the eastward of the Point are due entirely to the winds.

In the fall, young ice forms earlier to the eastward than to the westward and can be seen as early as mid-August. The prevailing winds are northeasterly and soon bring the pack down to the eastward of Point Barrow. When this ice movement commences vessels proceed to the westward of the point.

At Point Barrow young ice begins to form around heavy ice about mid-September and by the end of the month it forms in open water and makes rapidly along the beach. By this time the pack has moved close to shore. The young ice makes out to the pack during the first week of October, and then the ice is in for the winter. The pack shuts down on Icy Cape the first week in November, and after that time there is no open water between Point Barrow and Icy Cape except when the flaw opens.

Freezeup normally begins at Kotzebue in late October, and a southbound vessel should try to clear Bering Strait by early November.

Small-boat operation in ice.—Launches usually can proceed through the looser-packed floe ice during calm weather, but slow speed and maneuverability are essential. Passage frequently can be made close to shore when large floes have been driven in to the beach. Large bergs may also make leads through the more solid floes. Small ice cakes can be pushed aside in the looser areas. Caution must be observed to avoid the underwater projections of the larger bergs and the growler type of berg which is low in the water and difficult to see. The bergs have a tendency to roll or break with disturbances of any sort. Native launches prefer to operate close-to and in the lee of ice floes to take advantage of the smoother seas and will sometimes leave the mainland to proceed in the lee of offshore ice.

Chart 9380.—Cape Prince of Wales, on the Alaska side of Bering Strait, is the western extremity of **Seward Peninsula. Cape Mountain,** 2,289 feet high, is a mile back of the steep rocky shores on the southwest side of the cape; there is a radar tower on the mountain.

Tin City (1960 population 10) is on the beach about 2 miles southeast of Cape Mountain. The bight off Tin City affords northerly weather anchorage in depths of 10 fathoms a mile from sand beach which is steep enough for good landing. There is a Government airstrip near Tin City.

Wales (1960 population 128; P.O.), 2.5 miles northwest of Cape Mountain, is at the south end of a low sandy beach which extends 4 miles northward, then turns northeastward toward Shishmaref Inlet. The village has a mission, a school, a store, and radiotelephone communication. Small planes carrying mail and a few passengers land on the beach in front of the village.

Cape Prince of Wales Light (65°38′ N., 168°07′ W.), 15 feet above the water, is shown August 1 to November 1 from a small white house on the beach 2 miles northward of Wales.

Anchorage off Wales is in depths of 10 fathoms 0.8 mile from the beach. A narrow **naval restricted area** extends nearly 4 miles due west from the beach midway between Wales and the light; **see 207.804, chapter 2.** Caution is advised to avoid being dragged northward over the restricted area and on to Prince of Wales Shoal by the nontidal current which usually has a velocity of more than 1 knot.

Ice.—Average breakup in Bering Strait at Wales is in early June and average freezeup is about the first of December; **see appendix.** Navigation is difficult from early December to early June and is usually suspended from late December through April.

Prince of Wales Shoal is a narrow ridge of sand, covered 3½ to 5 fathoms, that extends about 35 miles north-northeastward from the western extremity of the cape. Vessels bound southward through Bering Strait should be careful not to fall too far eastward and be caught between the shoal and the northern shore of Seward Peninsula. The shoal is unmarked because of ice conditions and the remoteness of the locality.

Fairway Rock (65°38′ N., 168°44′ W.), 15 miles west

of Cape Prince of Wales, is 534 feet high, square headed, and steep sided. The rock has deep water on all sides, and there are no outlying dangers.

The Diomede Islands, midway between Cape Prince of Wales and the Siberian mainland, have nearly perpendicular sides and are without beaches; the tops of the islands are broken tablelands. The waters around the islands are deep, the bottom is mostly rocky, and anchorage is poor. The boundary between the U.S.S.R. and the U.S.A. passes between the two islands.

Little Diomede Island (Alaska), with an elevation of 1,308 feet, is 20 miles west-northwest of Cape Prince of Wales and 8 miles north-northwest of Fairway Rock. **Diomede** (1960 population 88), the only village on the island, is just north of the sandspit midway along the western shore. A reef extends westward from the sandspit toward the south end of Big Diomede Island. Vessels approaching Little Diomede Island from the south and east may run close along the south shore, keeping in depths greater than 14 fathoms until the village is sighted, and anchor south of the sandspit. Approach from eastward also has been made along north shore at distances decreasing from 1 mile to 0.4 mile and anchorage in depths of 17 fathoms 0.7 mile north of the spit.

Big Diomede Island (Siberia), 2.1 miles northwest of Little Diomede Island, rises to a height of 1,667 feet; close to the western shore are some bare rocks, and a light is shown from the northern end. Deep water is reported between the two islands but passage should not be attempted by large vessels.

Chart 9400.—Cape Dezhneva, 19 miles northwest of Big Diomede Island, is the eastern extremity of the mountainous peninsula at the northeastern end of the Siberian mainland. This peninsula, which rises to a height of 2,638 feet, resembles an island when seen from the offing because of the low, marshy land back of it. The coasts of the peninsula consist mainly of dark-colored cliffs rising in jagged terraces steeply from the sea. Lights are shown from the north and south sides of the cape, and there is a radiobeacon near the north light. A submerged rock is a mile off the northeast face of the cape. Anchorage, with good protection from offshore winds, can be found in depths of 8 fathoms both north and south of the meeting place of lowlands and mountains. Anchorage is also possible in depths of 10 fathoms, muddy bottom, east of the cape.

Chart 9400.—From Cape Prince of Wales to Shishmaref Inlet, 60 miles, the coast is a low sand beach backed by lagoons and marshes. The mountains in the interior can be seen on a clear day; **Potato Mountain,** 1,400 feet, and **Ear Mountain,** 2,300 feet, are distinguishable.

Shishmaref Inlet is large and extends about 15 miles into the land. Across its mouth is **Sarichef Island,** narrow and about 5 miles long. **Shismaref Light (66°15′ N., 166°04′ W.),** 50 feet above the water, is shown August 1 to November 1 from a white skeleton tower, 50 feet high, a mile from the northeast end of the island; the tower is one of the best landmarks along the beach.

Shishmaref (1960 population 217; P.O.), at the light on Sarichef Island, is the most important settlement along this section of the coast. The village has a conspicuous school, a mission, a store, a radio station, an airstrip, and limited supplies of gasoline, diesel fuel, food, and fresh water. Shishmaref uses Bering standard time.

Anchorage can be obtained in depths of 5 fathoms 1.3 miles west-northwest of Sishmaref Light. Beach landings can be made only in calm weather on the seaward side of Sarichef Island because of the shallow water that extends 250 yards from shore.

The navigable channel into Sishmaref Inlet rounds the northeast end of Sarichef Island; a dangerous bar makes out 0.5 mile from the point on the north side of the channel. Vessels drawing as much as 7 feet may be beached on the channel side of the sandy northeast end of Sarichef Island; drafts of 3 feet may be taken to within 100 yards of the inner beach southwest of Sishmaref, and native skiffs have followed unmarked channels completely around the island. Native pilots are available at Shishmaref.

Ice.—Average breakup at Shishmaref is in the latter part of June and average freezeup is about the second week of November; **see appendix.** Navigation is difficult from the first of December until late June and usually is suspended from late December until early June.

For 60 miles northeastward and eastward from Shishmaref Inlet the coast is a line of low bluffs and small sand dunes that end in a very low spit at **Cape Espenberg,** which is difficult to make out. Native settlements are scattered along the coast from Cape Espenberg to Cape Prince of Wales.

Northwest Corner Light (66°35′ N., 164°24′ W.), 100 feet above the water, is shown August 1 to November 1 from a small white house 19 miles west of the cape. **Cape Espenberg Light (66°34′ N., 163°36′ W.),** 25 feet above the water, is shown August 1 to November 1 from a small white house on the cape.

Kotzebue Sound, at the northeast end of Seward Peninsula, is entered between Cape Espenberg and Cape Krusenstern, 33 miles to the northward; depths are 6 to 9 fathoms throughout most of the sound.

The 30-mile western side of Kotzebue Sound from Cape Espenberg south is relatively shallow, with depths of 3 fathoms as far as 5 miles from shore; the land on this side is mostly low but a small hill is conspicuous about halfway between the cape and the southern shore.

The 45-mile southern shore of Kotzebue Sound proper is higher, rockier, and bolder than the western shore; inshore depths too are greater, with 4 and 5 fathoms quite close to the promontories. **Cape Deceit Light (66°06′ N., 162°45′ W.),** 190 feet above the water, is shown August 1 to November 1 from a small white house on the extremity of **Cape Deceit,** which is halfway along the south shore.

Deering (1960 population 95; P.O.), on the east side of Cape Deceit, has a school, stores, and radio communication; anchorage is available in depths of 5 fathoms a mile east of Cape Deceit Light.

Kiwalik Lagoon, in the southeast corner of Kotzebue Sound, is shallow and has a mud bottom. A narrow chan-

nel winds through the lagoon to **Kiwalik River** which can be navigated only with local knowledge. Shallow-draft boats can operate in the lagoon during periods of high water, but the lagoon is almost dry when the water is lowered by adverse winds.

Kiwalik (1960 population 10), on the gravel spit on the west side of the lagoon entrance, has a rough landing strip that will accommodate small planes; **the diurnal range of tide is 2.7 feet** at Kiwalik. **Candle** (1960 population 103; P.O.), about 6 miles upriver from Kiwalik, has stores, a school, and a gravel airstrip.

Spafarief Bay, also in the southeast corner of Kotzebue Sound but north of Kiwalik Lagoon, has depths of 3 to 5 fathoms.

Tundra-covered **Chamisso Island,** 231 feet high and about a mile long, is 11 miles northward across Spafarief Bay from Kiwalik Lagoon and 2.5 miles south of Choris Peninsula. The earth and rock bluffs that rim the island range in height from 15 feet at the south end to 80 feet at the northwest end. The shores are mostly broken boulders separated by short stretches of sand beach. Shallow water extends 0.3 to 0.5 mile from the north and east sides of the island. Early in the open season fresh water can be obtained on Chamisso Island.

Tiny **Puffin Island,** 0.3 mile northwest of Chamisso Island, has steep rocky shores; there are two conspicuous rocks south of the island. The waters are deep on the north and west sides of Puffin Island but the passage between the islands is foul.

Choris Peninsula, 300 feet in elevation, is a 6-mile southward projection from much larger and longer Baldwin Peninsula. The northerly of two hills on the small peninsula is joined to Baldwin Peninsula by a narrow neck of land about 20 feet in elevation. The outer end of Choris Peninsula is the widest part, 2 miles, of the entire feature; the bluffs are 50 to 95 feet high and there are projecting rock ledges. The passage between Choris Peninsula and Chamisso Island has depths of 3½ to 6 fathoms.

Eschscholtz Bay, behind Choris Peninsula, Chamisso Island, and Spafarief Bay, extends 20 miles eastward along the south side of Baldwin Peninsula and is mostly shallow. The shore at the head of the bay is rimmed with long muddy flats which bare at low water in some places as far as 0.3 mile from the beach. **Buckland River,** which empties into the head of Eschscholtz Bay, is large but shallow and has little traffic; **Buckland** (1960 population 87), 10 miles upriver, has a radio station.

Northward of Choris Peninsula, **Baldwin Peninsula** is low for some distance, then rises to low bluffs which continue to the mouth of Hotham Inlet, 40 miles to the northwestward. The faces of the bluffs are deeply furrowed by the gradual melting and sliding of the surface ice and frozen mud.

Cape Blossom is a distinctive point in the Baldwin Peninsula bluffs, which are highest at the point and slope to either side. **Cape Blossom Light (66°44′ N., 162°32′ W.),** 200 feet above the water, is shown August 1 to November 1 from a small white house on the cape.

Hotham Inlet entrance, 15 miles north of Cape Blossom and 30 miles east-southeast of Cape Krusenstern, is obstructed by vast mud flats and sandbars, some of which are bare at low water; the 3-fathom curve extends as much as 9 miles from shore and nearly as far south as Cape Blossom. The inner waters of Hotham Inlet are 4 to 15 miles wide and extend 45 miles southeastward behind Baldwin Peninsula; charted depths are 1 to 2 fathoms in what passes for a channel through this inner expanse, which has been known locally as **Kobuk Lake.** Landings cannot be made at many places in Hotham Inlet because of the extensive mud flats. The waters are little influenced by tides and are mostly fresh because of the near absence of any eastward current; prolonged southeast winds lower the level.

Kotzebue (1960 population 1,290; P.O.), 11 miles north of Cape Blossom and on the outer south side of Hotham Inlet entrance, has a school, a hospital, missions, stores, banking facilities, fur farms, airstrips, an aero light and radiobeacon, and radiotelephone communication; the town uses Bering standard time. Vessels of less than 6-foot draft can reach the town if they know the channel, which is shifting and difficult to follow; oil-drum buoys are in place August 1 to November 1 but they are unreliable and hard to pick up. Local pilots are available at Kotzebue.

Deep-draft vessels approach Kotzebue as closely as possible and lighter their freight ashore. The usual anchorage for deep-draft vessels is in depths of 5 to 6 fathoms 3 to 6 miles southwest of Cape Blossom; protection is afforded from northerly and easterly winds. The trip by small boat from the anchorage to Kotzebue is about 15 miles and over many sandbars that are constantly shifting; local pilotage is advised.

Currents.—The average velocity of the tidal current is about 0.5 knot at the anchorage southwest of Cape Blossom; the flood sets southeastward and the ebb northwestward. Observations at this location show a northwestward nontidal flow which sometimes has sufficient velocity to overcome the flood of the tidal current and produce a continuous northwestward current of varying velocity for days at a time. This northwestward flow attains maximum velocities of 1 to 2 knots at times of tidal current's ebb strength.

Ice.—Average breakup in Kotzebue Sound at Kotzebue is about the last of May and average freezeup is in the latter part of October; **see appendix.** Navigation is difficult from late October to the latter part of June and usually is suspended from the second week in November to mid-June.

Noatak River, which empties into the north side of Hotham Inlet entrance, has numerous rapids and is not navigated for any great distance by anything larger than a canoe. The natives portage from the headwaters of Noatak River to Chipp River and follow the latter to Beaufort Sea. **Noatak** (1960 population 275; P.O.), about 35 miles upriver from Hotham Inlet, has an airstrip and a radio station.

Kobuk River empties in to the east side of Hotham Inlet through a many-mouthed delta which extends inland for about 30 miles; depths off the delta are 2 to 4 feet for

as much as 3 miles. The delta channels are difficult to navigate but the river proper is comparatively wide and deep. The natives portage their canoes from the headwaters of Kobuk River to Koyukuk River, a tributary of the Yukon.

Noorvik (1960 population 384; P.O.), 25 miles up Kobuk River from Hotham Inlet, has a hospital, an airstrip, and a radio station. **Kiana** (1960 population 253; P.O.), at the junction with **Squirrel River** 45 miles up the Kobuk from the inlet, has stores, a school, an airstrip, and a radio station. Much farther up Kobuk River from the inlet are **Shungnak** (1960 population 135; P.O.), 150 miles, and **Kobuk** (1960 population 54; P.O.), 155 miles; both have airstrips and Shungnak has a school, a mission, and a radio station.

A narrow passage 4 miles long and a mile wide connects the southeast end of Hotham Inlet with **Selawik Lake,** which extends 35 miles farther eastward and averages 15 miles in width. A depth of 2 fathoms can be taken around the lake by giving the shores a wide berth. **Selawik River,** which empties into the east end of the lake through a maze of islands, has several entrances which are obstructed by mud flats; navigable entrance depth is uncertain but presumably is shallow. **Selawik** (1960 population 348; P.O.), near one of the entrances, has a school, a mission, a radio station, and an airstrip.

The coast is low from Hotham Inlet to Cape Krusenstern, and shallow water extends nearly half the distance from the mouth of the inlet toward the cape; the edge of the shoal is steep and should be approached carefully. For the rest of the distance there are depths of 4 to 6 fathoms close to the beach.

Behind **Cape Krusenstern (67°07′ N., 163°46′ W.)** is a high, prominent range of mountains which can be seen from great distances. On closer approach, the mountains are seen to fall away toward the cape in a series of steps and must not be mistaken for the low cape when shaping a course into Kotzebue Sound. A shoal extends 3 miles northwestward from the north side of the cape.

North of Cape Krusenstern the coast is a low, shingle beach backed by numerous lagoons which discharge through small shallow openings. The high ground behind the cape coutinues at some distance inland to **Mulgrave Hills,** about 30 miles north of the cape. Beyond the hills is a wide plain which extends another 30 miles before the mountains again approach the coast and slope down to the water.

About 42 miles north-northwest of Cape Krusenstern is the inlet to a lagoon which extends another 8 miles northwestward behind the barrier beach which separates it from the ocean. **Kivalina** (1960 population 142; P.O.), on the barrier beach near the inlet, has a school, a store, a radio station, and an airstrip. Small-craft anchorage is available along the inner side of the village where the channel bears in close to shore. Shifting shoals extend as much as 0.3 mile from either side of the inlet, and entrance should not be attempted without local pilotage.

Ice.—Average breakup at Kivalina is in the latter part of May and average freezeup is in the latter part of October; **see appendix.**

At **Cape Thompson,** 80 miles northwest of Cape Krusenstern, the mountains drop directly to the water in a series of steep bluffs and cliffs about 500 feet high and 6 miles long. Thousands of sea birds nest along the bluffs and their eggs are an Eskimo source of fresh food supply in early summer.

The coast is without distinct promontories. About midway along the Cape Thompson cliffs is a rugged mountain face that has at its southern end a distinct series of strata in an irregular semicircle. In the ravine south of this point is a small stream from which fresh water can be easily obtained. Directly off the stream, anchorage can be had in depths of 5 fathoms, sandy bottom. At other places along the cliffs the bottom is mostly rocky.

In the bight 1 mile north of Cape Thompson, the water is fairly deep close to shore and remains calm in the severest northerly and easterly storms. Good anchorage, with sand bottom, is available for small craft. A 69-ton vessel has been brought to within 75 yards of the shore without grounding. Good water can be obtained from any of several streams.

From Cape Thompson the mountains continue northward to Cape Lisburne, while the coast curves northwestward and westward to Point Hope.

Point Hope, 22 miles northwest of Cape Thompson and 102 miles from Cape Krusenstern, is the seaward extremity of a low tongue of land that projects 16 miles westward from the general line of the coastal mountains. The point has a steep shingle beach which is backed by numerous lagoons. The village of **Point Hope** (1960 population 324; P.O.), is the most important settlement along this part of the coast and has a school, a mission, a store, a radio station, and an airstrip. **Point Hope Light (68°22′ N., 166°40′ W.),** 26 feet above the water, is shown August 1 to November 1 from the top of the schoolhouse.

Depths of 4 fathoms are found as far as 5 miles westnorthwest of Point Hope, and a 3-fathom shoal is a mile from shore 6 miles east-southeast of the point. Vessels have anchored in depths of 6 fathoms a mile southeast of the light and in 5 fathoms 0.5 mile northeast of the light; the bottom is hard mud and only fair holding ground throughout the Point Hope area.

Ice.—Average breakup at Point Hope is in the latter part of June and average freezeup is about the second week of November; **see appendix.** Navigation is difficult from the latter part of November until mid-July and usually is suspended from early December until the latter part of June.

Marryatt Inlet, 10 miles east-northeast of Point Hope Light, is the entrance to a large lagoon; a draft of 5 feet can be taken through the inlet but those not familiar with the channel should be cautious about entering. When the ice breaks in the lagoon, there is a strong outflowing current and the moving ice is more or less dangerous. Depths off the inlet range from 1½ fathoms near shore to 3½ fathoms at a distance of 4 miles.

North of Marryatt Inlet the mountains slope down to

rugged shore cliffs. The few ravines in the cliffs have running streams with shore outlets where fresh water can be obtained.

Cape Lisburne, 35 miles north-northeastward of Point Hope, is a bare brown mountain 849 feet high. This rugged headland is distinctively marked by the pinnacles and rocks near its summit, and its shore faces are very steep. The cliffs are rookeries, and during the summer months the sky is sometimes darkened by flights of birds. The wind rushes down from the mountains in gusts of great violence and varying directions, and at such times passing vessels should stay well off the cape.

The coast turns abruptly eastward from Cape Lisburne. The land is lower; the hills are rounded and rolling and slope to the sea. Toward **Cape Sabine,** 35 miles east of Cape Lisburne, is a series of ridges that terminate at the coast in bluffs. Cape Sabine is the outer end of one of the ridges and projects but slightly from the general line of the coast. Veins of coal 1 to 4 feet thick show plainly along the tops of the bluffs at Cape Sabine; some of the veins have been worked but use of the coal is limited because of its poor quality and the difficulty of mining it.

From Cape Sabine, the land continues of a rolling character until near **Cape Beaufort,** a dark mountain that comes down to the coast 52 miles east by north of Cape Lisburne. There is no appreciable break in the coast at Cape Beaufort, and it probably was named a cape because it is the most northerly extension of high ground along the coast of Alaska. At this point the mountains recede inland and the coast continues low.

About 18 miles northward of Cape Beaufort is the southern extremity of **Kasegaluk Lagoon,** which extends to within a few miles of Wainwright Inlet. Southward and eastward of Icy Cape the lagoon is blocked by an extensive area of marsh; there is no passage behind the cape even for native skin-boats. Separating the lagoon from the ocean is a narrow sand barrier, only a few feet above the water; south of Icy Cape are several small, shallow passages through the barrier and there are two larger openings north of the cape. The land on the inner side of the lagoon is mostly low but there are some small bluffs with rolling terrain behind them. South of Icy Cape, Kasegaluk Lagoon has **Kukpowruk River, Kokolik River, Utukok River,** and several smaller streams emptying into it but its whole expanse is filled with flats and bars that make it scarcely navigable even for native canoes.

Kukpowruk Pass, 41 miles north-northeast of Cape Beaufort, has a controlling depth of about 6 feet into Kasegaluk Lagoon and southward for about 2 miles through a narrow channel along the inner side of the barrier beach; the channel leads to fair anchorage, protected from all directions. Northeast winds will lower the water level about 3 feet, and the pass changes from year to year because of ice scouring. There is no channel northward through the lagoon to Point Lay.

Point Lay is a slight bend in the barrier beach 49 miles north-northeast of Cape Beaufort. The village of **Point Lay** (1960 population 20) is on the beach 3 miles south of the point. Anchorage is in depths of 6 fatboms 1.5 miles off the village. There is a prominent **Aero Radiobeacon (69°44′ N., 163°00′ W.)** at the airstrip on the mainland 2 miles southeast of the village.

Ice.—Average breakup at Point Lay is in late June and average freezeup is in early November; **see appendix.** Navigation is difficult from early November to late June and usually is suspended from mid-December to late June.

Icy Cape Pass, 2 miles southwest of the cape, has a controlling depth of about 5 feet but entrance requires knowledge of bar and channel conditions. Fair anchorage is available in depth of 5 to 7 feet in Kasegaluk Lagoon southwest of the pass. A **radar tower** and an airstrip are on the mainland opposite the pass. Fresh water can be obtained from a stream southwest of the tower.

Icy Cape, 40 miles northeast of Point Lay and 125 miles from Cape Lisburne, is a sharp turning point in the low flat barrier beach that separates Kasegaluk Lagoon from the ocean. A **Radar Tower (70°20′ N., 161°52′ W.),** 100 feet high, and a house are near the point of the cape.

Blossom Shoals, which extend 6 to 8 miles off Icy Cape, are a number of ridges that parallel the coast. In the approach to the shoals, the bottom is lumpy and depths are irregular. The shoals are usually given a wide berth, and it is recommended that vessels rounding the cape stay in depths greater than 12 fathoms.

The shoals are the approximate southern limits of the inshore ice during the July–September season for navigation in this area. The ice moves inshore and offshore with the winds and, as the shoals form a salient at this part of the coast, open water may extend north or south of them, but access from one open-water area to another may be blocked by ice on the other side of the shoals.

Blossom Shoals show evidence of ice scour and probably change from year to year. Surveys made in 1948–50 found depths of 10 feet 0.9 mile off Icy Cape, 16 feet 2 miles off, 20 feet 3.3 miles off, 19 feet 4.4 miles off, 26 feet 6.4 off, and 37 feet 7 miles off.

There are deep channels between the outer shoals. One that has been used by commercial vessels rounds the radar screen on Icy Cape at a distance of 2.5 miles with minimum depths of 32 feet. Another, recommended by the survey party, rounds the cape at a distance of 3.8 miles with no depths less than 35 feet. About 6 miles off the cape, and just inside the outermost shoals, is a passage with minimum depths of 10 fathoms.

Behind the barrier beach that extends eastward from Icy Cape, **Kasegaluk Lagoon** has midchannel depths of 9 to 11 feet; numerous shoals project from both sides of the lagoon. The ice in the lagoon breaks up about 10 to 15 days after the sea ice has moved out. New ice forms about the middle of September and soon becomes about 6 inches thick. Launches not more than 4½ feet in draft may pass around **Nokotlek Point,** on the mainland 18 miles east of Icy Cape, through a very narrow channel.

Akoliakatat Pass, 12 miles east of Icy Cape, has a narrow channel close to shore on the western side; a controlling depth of about 7 feet can be carried into Kasegaluk Lagoon at normal tide levels. Anchorage can be found back of the pass in depths of 7 to 10 feet, good holding ground. The current in the pass may reach a velocity of 2 knots with strong southwest or northeast winds. A

continuous period of northeast winds will lower the water as much as 3 feet below normal levels.

Pingorarok Pass, 22 miles east of Icy Cape, has a controlling depth of 5 feet into Kasegaluk Lagoon through a very narrow channel on the eastern side. Breakers usually mark the shoals on both sides of the entrance.

Wainwright Inlet, 39 miles east-northeast of Icy Cape, is the entrance to **Wainwright Lagoon.** The narrow winding channel between **Point Collie** on the east and **Point Marsh** on the west has a controlling depth of 6 feet at normal water level, but passage should not be attempted without the aid of local guides. Shoals extend 0.7 mile off the inlet and are well defined by breakers during moderate weather; during westerly storms the breakers stretch across the channel. Ice, which may enter the inlet during southwest storms, follows the channel, where the current reaches a maximum velocity of about 2 knots. The mean range of tide is only about 0.5 foot.

Wainwright (1960 population 253; P.O.), on the beach 2.5 miles northeast of the inlet, has stores, a school, a church, and an airstrip. **An Aero Radiobeacon (70°37′ N., 159°52′ W.)** is about 3 miles southeast of the village.

Ice.—Average breakup at Wainwright is about the last of June and average freezeup is about the first of October; **see appendix.** Navigation is difficult from early November to mid-July and usually is suspended from early December to early July.

Kuk River, which empties into the head of Wainwright Lagoon, has an even bottom and no definite channel. Depths decrease gradually from 10 feet at the lagoon to a reported 4 feet some 30 miles upriver. Three outcroppings of usable coal are 8 to 18 miles from the mouth.

Point Franklin (70°54′ N., 158°47′ W.), 70 miles east-northeast of Icy Cape, is the eastern end of the barrier sand beach that extends 8 miles along the northwest side of Peard Bay.

A mile east of Point Franklin is the northern extremity of the narrow barrier **Seahorse Islands,** which extend south-southeastward for 3 miles. The largest island has an elevation of about 20 feet, which is the greatest along this series of barriers. Between Point Franklin and the Seahorse Islands is a narrow, winding channel with a least depth of about 4 feet; this channel may vary from year to year.

A shoal makes out to northward from Point Franklin. Depths less than 1 fathom extend out 1.2 miles; the 5-fathom curve is about 2 miles offshore, and the 10-fathom curve is 2.6 miles offshore.

Protection from southerly to westerly weather is available northeast of Point Franklin and the Seahorse Islands. This shelter does not afford protection from ice.

A current sets northeast along the shore except during strong northeasterly winds. It is estimated that the velocity is 1 to 2 knots under ordinary conditions. This northeast current forms a big eddy which circulates in a clockwise direction in the bight east of Point Franklin. The eddy extends about 20 miles to the northeastward of the point and 5 to 6 miles from shore.

When there is ice in this vicinity **abnormal refraction** can be expected at any time. A large amount of refraction can be expected at all times, whether or not ice is present.

Peard Bay, behind the barrier beaches of Point Franklin and the Seahorse Islands, has uniform depths of about 20 feet over the greater part of its area. The bottom, which is mud and clay, is excellent holding ground. A depth of 12 feet can be carried into Peard Bay through a narrow channel just off the south end of the Seahorse Islands. A depth of about 8 feet can be carried into the bay on either side of the 4-foot shoal which is about 1 mile southeast of the southern end of the islands. The bay affords good protection from heavy southerly and southwesterly winds. A small spit in the southeasterly part of the bay affords protection for small boats from winds from any direction.

At the southwest end of Peard Bay is **Kugrua Bay,** into which **Kugrua River** empties. A draft of about 4 feet can be carried into Kugrua Bay; depths in the middle of the bay are 10 to 12 feet. In the northeast corner of the bay is a sandspit which affords good protection from all weather for small boats.

From Peard Bay eastward and northeastward to Barrow the coast is rimmed with mud bluffs 25 to 90 feet high and furrowed by numerous small streams; the highest is **Skull Cliff,** 20 miles east of the bay. The coast has no projecting points or shoals and the 5-fathom curve is 0.5 to 1.0 mile from shore, but depths may vary as much as a fathom from year to year because of ice gouging. There is no protection from heavy weather.

The Will Rogers Memorial (71°09′ N., 157°04′ W.) is a 12-foot concrete monument on the northeast side of a wide stream 10 miles southwest of Barrow.

Barrow (1960 population 1,314; P.O.), 8.5 miles southwest of Point Barrow, has a hospital, a school, a church, a radio station, and several stores; limited quantities of supplies include gasoline, diesel fuel, food, and clothing. Air-freight service is available throughout the year. An **Aero Radiobeacon (71°19′ N., 156°40′ W.)** is 2 miles northeast of Barrow.

Point Barrow (71°23′ N., 156°28′ W.), the northernmost point of land in the United States, is the seaward end of a gravelly sandspit that extends 3 miles northeastward from the rest of the mainland. The point is also the northeastern corner of Chukchi Sea and the southwestern corner of Beaufort Sea. The northern limit of **Beaufort Sea** is a line from Point Barrow to Lands End, Prince Patrick Island, Canada.

Tides and currents.—The diurnal range of tide is about 0.5 foot at Point Barrow. During the survey of May August 1945, the current northwest of the point was observed to flow constantly in a northeasterly direction at an estimated strength of 3 to 4 knots; along the northeast side of the point the current flowed in a northwesterly direction at an estimaed strength of 1 knot. Judging from the movement of the icebergs, there seemed to be an eddy centered several miles northeastward of the point.

Ice.—Average breaknp at Barrow is in late July and average freezeup is in early October; see appendix. Navigation is difficult from mid-October to late July and usually is suspended from early December to early July.

The ice barrier that extends from 0.5 mile off Barrow to

1.5 miles northwestward of Point Barrow can be dangerous to navigation. Formed when onshore winds drive icebergs aground, the barrier may break and drift seaward during heavy offshore winds. While aground the barrier keeps the main ice pack from drifting onto the beach and often gives protection along its inner side to shallow-draft vessels. During periods of offshore winds, leads may open in the barrier through which, when winds reverse to onshore, small bergs sometimes drift to block the inshore waters and stop all navigation.

During the 1945 survey the main ice pack was never out of sight from Point Barrow. When the pack opened to the westward it closed to the eastward and vice versa. Icebergs 30 to 50 feet high floated around continuously; some grounded at about the 5-fathom curve and remained stationary for a week or more until the wind changed with sufficient force to dislodge them.

In general, the main ice pack drifts with the winds and currents during the months of July through September and permits intermittent navigation outside the ice barrier. Outside navigation is impossible when the pack drifts shoreward; inside passage possibly can be made behind the barrier but charted depths may not be too reliable because of berg gouging.

Medium-draft vessels should be able to round Point Barrow at a distance of 1 mile; 30-foot drafts should stay at least 3 miles off. **Caution:** A 1957 report places a 25-foot shoal 7 miles northeast of Point Barrow; this may indicate a possible northeastward extension of Point Barrow spit. If passage must be made east of Point Barrow, August is the best month for the attempt.

Elson Lagoon extends from Point Barrow to **Christie Point,** on the mainland 21 miles to the southeastward. The lagoon is 2 to 5 miles wide and has depths of 8 to 11 feet. Between the lagoon and Beaufort Sea are the barrier **Plover Islands** which are low and difficult to distinguish except in periods of good visibility. The islands and the mainland are barren stretches as viewed from offshore and are covered by snow and ice most of the year; there is nothing distinctive in the area.

Eluitkak Pass, the most westerly entrance to Elson Lagoon, is between tiny **Doctor Island** and the spit that extends 2.5 miles southeastward from Point Barrow; depths in the pass equal or exceed those in the lagoon. **Deadmans Island** and **Tapkaluk Island** are southeast of Doctor Island.

Ekilukruak Entrance, 15 miles southeast of Point Barrow, is between Tapkaluk Island and **Cooper Island,** 4 miles to the southeastward; the passage into Elson Lagoon has depths of 5 to 7 feet. Cooper Island is one of the largest of the Plovers and is midway along the chain.

Sanigaruak Pass, 24 miles southeast of Point Barrow, is a narrow but well defined channel through the Plover Islands at the west end of **Sanigaruak Island;** the controlling depth is about 6 feet into Elson Lagoon. **Igalik Island,** last major island of the Plover group, is between Sanigaruak Island and Tangent Point to the southeastward.

Dease Inlet, behind the southeastern Plover Islands, is 10 miles wide between Christie Point and Tangent Point and extends inland about 20 miles. The inlet has depths of 8 to 10 feet except for the shallows near the beaches. The principal entrances are from Elson Lagoon and Sanigaruak Pass. **Tiny Island** and **Oarlock Island,** known as the **Kikiktak Islands,** are 10 to 15 miles up Dease Inlet from Christie Point; on Tiny Island is a small fresh-water lake. **Admiralty Bay,** at the head of Dease Inlet, has depths and bottom similar to the outer part of the inlet; several rivers empty into the bay.

During the 1945 survey of this area, the winter ice did not break up in Elson Lagoon until July 28 and started forming again on September 13. The survey launches had a difficult time getting out of Dease Inlet on September 15 at which time the entire inlet and lagoon were frozen over entirely to a thickness of 1 inch. In the winter, the ice freezes to a thickness of 6 to 10 feet.

Tangent Point, 30 miles southeast of Point Barrow, is the low, flat, tundra promontory on the east side of the entrance to Dease Inlet. There is a shallow entrance channel between the point and the islands to the northwest.

The islands along the coast from Tangent Point to Mackay Inlet, 5.5 miles to the southeast, are low sand barriers separated from the mainland by mud flats and shallow lagoons. These rapidly changing islands have steep beaches on their seaward sides, with depths of 8 feet or more only 100 yards off. Deep channels open and close through the islands during summer storms.

Mackay Inlet is the only shelter for small boats between Tangent Point and Cape Simpson, and this shelter is extremely limited because of the shallowness of the lagoons behind the islands. Remarks concerning frequent changes in channels are particularly applicable to Mackay Inlet.

The bluffs along the coast from Mackay Inlet to Cape Simpson vary in height from 4 to 15 feet; the land behind is marshy and has numerous lakes. Launches may proceed safely along this stretch of coast at a distance of about 100 yards.

Cape Simpson is a low promontory 14 miles southeast of Tangent Point. There are shoals and sandbars near the cape but no shelter for small boats.

Smith Bay, between Cape Simpson and Drew Point, 14 miles to the southeast, extends 8 miles back of the entrance points and has general depths of 3 to 10 feet. Along the west shore of the bay, rapid erosion of the 10- to 20-foot bluffs has caused shoaling, and launches drawing 3 to 4 feet must stay 0.2 to 0.5 mile off, but there is still some protection from westerly weather.

The delta of **Ikpikpuk River,** which empties into the head of Smith Bay, is building out steadily. Extensive shoals are forming as much as 3 miles out, and the 3-foot curve is 1 to 2 miles off the delta. The southeast side of the bay is very shallow; the 3-foot curve is 2 to 3 miles offshore.

Along the east side of Smith Bay are intermittent bluffs. The only possible landing place for small craft is on **Drew Point,** at the entrance. Boats drawing less than 2½ feet can anchor south of the sandspit at the point.

Pitt Point, 69 miles east-southeast of Point Barrow, is about halfway between Smith Bay and Harrison Bay. An

Aero Radiobeacon (70°54′ N., 153°14′ W.) is on the west side of the point. On the southeast side is a large, shallow lagoon which is separated from Beaufort Sea by a narrow sand barrier. Heavy seas open and close passages that have been used by native launches. There are depths of 8 to 10 feet 200 yards off Pitt Point.

Cape Halkett is a low promontory 20 miles east-southeast of Pitt Point. A 1-foot shoal is 0.7 mile east of the cape; between the shoal and the cape are depths of 5 feet.

Harrison Bay is between Cape Halkett and Oliktok Point, 50 miles to the east-southeastward; the inland extent is about 15 miles from the general line of the coast. The inner part of the bay is very shallow, and the Colville River delta projects several miles from the southeastern side. **Pacific Shoal,** 3 to 5 feet deep and 5 miles in north-south length, is centered about 8 miles southeast of Cape Halkett.

Saktuina Point, 14 miles southward from Cape Halkett, is the easternmost tip of the narrow peninsula which forms the north side of Kogru River. **The Eskimo Islands,** a mile east of Saktuina Point, have bluffs up to 20 feet in height.

Kogru River is a series of connected lakes that form a 10-mile-long lagoon which empties into Harrison Bay between Saktuina Point and the Eskimo Islands. Entrance depth is about 4 feet and greater depths are reported inside.

Atigaru Point, 7 miles eastward of Saktuina Point, is a low headland with extensive bars and shoals to the east and southeast. Natives report fair anchorage for small craft 3 miles south of the point.

Colville River, the largest along the Arctic coast of Alaska, has a delta that extends 20 miles along the southeast side of Harrison Bay. There are three major channels and numerous minor channels through the delta. It is probable that a draft of 3 feet can be taken over the entrance bars and upriver to the rapids a few miles below the mouth of **Anaktuvuk River,** which empties into the Colville 75 miles from Harrison Bay.

Oliktok Point, the first prominent mainland point east of Colville River, is a triangular sandflat with elevations of as much as 5 feet. There is an **Aero Radiobeacon (70°30′ N., 149°53′ W.)** on the point. Excellent small-boat anchorage is found in depths of 5 feet behind the small bar that extends northwestward from the point; this anchorage is exposed to southwesterly weather, but protection from such can be found east of the point.

Thetis Island is 6 miles northwest of Oliktok Point and 5 miles off the Colville River delta. Good anchorage, with protection from southwesterly winds, is found in depths of 12 feet east of the island.

Spy Island, 3 miles north of Oliktok Point and 4 miles east of Thetis Island, is the westernmost of the **Jones Islands;** the island is very low and floods during storm high waters. **Pingok Island,** largest and highest of the Jones group, is 8 miles long in an east-west direction and has several dunes or mounds. **Bertoncini Island** and **Bodfish Island** are about 2 miles east of Pingok Island; both are tundra covered and have bluffs along their shores. **Cottle Island,** 1.5 miles northeast of Beechey Point, is 3 miles long and is the easternmost of the Jones group. Bars and shoals obstruct the passages between Pingok and Cottle Islands.

On the mainland back of the Jones Islands is **Milne Point,** which is 8 miles east of Oliktok Point and is rimmed with bluffs about 5 feet high. **Beechey Point** is 14 miles east of Oliktok Point; launches can find fair shelter in depths of 4 feet behind the small sandbar that extends northwestward from Beechey Point.

Simpson Lagoon, between the Jones Islands and the mainland, has depths of 6 feet and affords protected passage from Oliktok Point to Beechey Point.

The **Return Islands** begin a mile southeast of Cottle Island and continue southeastward another 11 miles. **Long Island** is the westernmost and longest, about 6 miles, of the Return group; the passage between Cottle Island and Long Island has depths of 2 feet. Off the southeastern end of Long Island are bars and shoals that extend back into Gwydyr Bay, but depths of 5 feet can be carried into the bay between the bars and low, crescent-shaped **Egg Island,** next island to the southeastward. Southeasternmost of the Return group is **Stump Island,** which is about 2 miles long and extends to within 0.5 mile of mainland Point McIntyre. The passage between Egg Island and Stump Island has depths of 3 feet, but there is little water between Stump Island and Point McIntyre.

Gwydyr Bay, the lagoon area between the Return Islands and the mainland, has depths of 3 to 5 feet as far east as low **Point Storkersen,** which is 10 miles from Beechey Point; the best entrance to the bay is west of Egg Island. **Kuparuk River** empties into the south side of Gwydyr Bay west of Point Storkersen. There is little water between Point Storkersen and **Point McIntyre,** 3 miles to the southeastward.

From the Return Islands to Brownlow Point, barrier islands parallel the coast and are separated from it by an extensive lagoon. The mainland is low tundra with very little relief except for three prominent mounds west and southwest of Tigvariak Island. The mainland shore consists of low bluffs, up to 35 feet in height, cut by river flood plains and deltas. The barrier islands are low sand and gravel reefs less than 8 feet in elevation; the larger islands have some sparse vegetation. Between the islands are many shoals and bars that are awash. The lagoon between the islands and the mainland has depths of as much as 30 feet but also has many areas too shallow for navigation by small boats. The lagoon is 2 to 10 miles wide and extends in a continuous line from the Return Islands to Brownlow Point. Vessels following the coast may avoid the heavy ice that is nearly always present off the barrier islands by passing inside the islands by way of one of the deeper entrances. Ice frequently blocks these entrances, but passage usually can be made through leads.

The **Midway Islands,** 7.5 miles northeast of Point McIntyre, are very low and have little driftwood on them; good anchorage for vessels drawing up to 6 feet can be found behind the westerly island.

Cross Island is 6 miles east of the Midways. Somewhat protected anchorage for vessels drawing up to 10 feet can be found behind the crescent-shaped island and the several

small islets that extend to the southward. Large ice floes remain hinged to the north and east sides of the island during the entire open season. Two miles southeast of Cross Island is a shoal that extends 4 miles in a southeasterly direction; a gravel islet 3 feet high is halfway along the shoal.

Prudhoe Bay, southeast of Point McIntyre, has shoals across most of its entrance; a small island is midway along the shoals. The bay proper has depths of 6 to 9 feet and affords good holding anchorage with protection from all but northwesterly weather. The best access route has depths of 4 feet and parallels the westerly shore at a distance of 0.4 mile.

Heald Point, on the east side of Prudhoe Bay entrance and 8 miles from Point McIntyre, is a 15-foot-high tundra bluff with a narrow sand beach at its base. Three small sand islets extend northwestward from the point.

The delta of **Sagavanirktok River** extends the 9 miles from Heald Point to Foggy Island. The waters off the delta are extremely shallow and small boats find landing very difficult. **Howe Island,** 5 miles east of Heald Point, is near the middle of the delta area and is prominent from seaward; the island is a mile long, 0.2 mile wide, and has an elevation of 35 feet near its eastern end. A mile east of Howe Island is **Duck Island,** a small silt mound, and 4 miles east of Howe Island is **Point Brower,** the northern extremity of tundra-covered **Foggy Island,** which is part of the delta and separated from the mainland by two branches of the river.

Foggy Island Bay, which extends 12 miles along the mainland between Foggy Island and Tigvariak Island, has depths of as much as 20 feet but has wide shallow areas along its east and west sides.

Tigvariak Island, close to the mainland, is 2 miles long, 1 mile wide, and has elevations up to 30 feet. The tundra of Tigvariak Island is dotted with lakes and ponds from which fresh water is obtainable; the shores of the island are mostly sand beaches backed by bluffs ranging in height from 5 to 30 feet. At the eastern end of the island is **Reliance Point,** a sandspit that extends 0.8 mile to the southward, and on the northeast side is a large sea-level lake which is separated from the ocean by a sand barrier. **Lion Point** is the outer end of a long sandbar that begins 0.3 mile from the north end of Tigvariak Island and continues 0.8 mile to the northwestward.

Mikkelsen Bay, between Tigvariak Island and **Savakvik Point,** 7 miles to the east-southeastward, has depths of as much as 18 feet which decrease gradually as the beach is approached. An **Aero Radiobeacon (70°11′ N., 146°51′ W.)** is on Savakvik Point.

Returning to the island chain off the mainland, **Narwhal Island,** northwesternmost of the **McClure Islands,** is 10 miles southeast of Cross Island and 8 miles northeast of mainland Foggy Island. Narwhal has some vegetation and there is some driftwood on it; near the center of the island are several small ponds. Protected anchorage is available in depths of 15 feet behind the northwest end of Narhwal Island; depths of 7 feet extend 0.5 mile southwestward from the middle. Little ice is encountered during the open season, and the anchorage can be approached from the southwest. The passage between Narwhal Island and Jeanette Island, a mile to the southeast, has irregular depths but can be navigated without difficulty by vessels drawing less than 7 feet.

Jeanette Island and **Karluk Island,** 2.5 miles apart, are at opposite ends of the crescent-shaped series of small sand islets, some as much as 5 feet high, which forms the southeastern part of the McClure group. These islets are exposed to vigorous ice and wind action, and there is continuous change in the shorelines and in the shallower depths. Protected anchorage is available in depth of 9 to 15 feet south of the islets.

Newport Entrance is between Karluk Island of the McClure group and Pole Island, westerly of the two major **Stockton Islands,** 5 miles east-southeast of the McClures. A sandbar is a mile south-southeast of Karluk Island, and a second sandbar is 2.3 miles southeast of the island; the two bars are only a few yards in width and are awash during storm high waters. Shoals extend 1.5 miles westward from Pole Island. Vessels drawing less than 7 feet can pass between Karluk Island and the two sandbars, but caution is advised because of the current action and berg gouging. The principal passage through Newport Entrance is between the sandbars and the Pole Island shoal; least depth is 16 feet over a width of a mile. Heavy ice remained in Newport Entrance throughout the 1949 open season.

Pole Island, 5 miles northeast of mainland Tigvariak Island, is a narrow sand barrier 2 miles long and has elevations up to 5 feet; the island has some vegetation, a few small ponds, and a considerable amount of driftwood. **Belvedere Island,** easterly of the Stockton Islands, also is a narrow sand barrier about 2 miles long. The passage between the two islands is 0.2 mile wide and has a controlling depth of 5 feet.

Challenge Entrance is between Belvedere Island and Challenge Island, 6 miles to the southeastward. The west side of the opening and the area immediately south of Belvedere Island are shallow and dotted with tiny islets and bare shoals. The best water is 0.8 mile west of Challenge Island where vessels drawing 10 feet or less can enter with safety.

Challenge Island, the westernmost of the **Maguire Islands,** is a strip of sand about 0.5 mile long and 3 feet high. **Alaska Island,** which begins 0.2 mile east of Challenge Island and continues 3 miles farther eastward, is a very narrow sand and gravel formation; the easternmost third has been cut through in several places and is a series of sandbars, shoals, and islets. There is no channel between Challenge and Alaska Islands.

Duchess Island, a mile east of Alaska Island, is a mile long and 5 feet high. There is a narrow channel between Duchess and Alaska Islands but it is not recommended.

Northstar Island, 0.2 mile southeast of Duchess Island and easternmost of the four principal Maguires, is another narrow sand barrier about a mile long and has extensive shoals on the south and southeast sides. There are narrow channels at both ends of the island but they are shallow and subject to constant change.

Mary Sachs Entrance, between Northstar Island and Flaxman Island, has extensive shoals on both east and west sides. There is a 0.7-mile-wide passage with depths of 10 feet about midway between the two islands.

Flaxman Island, which begins 2 miles east-southeast of Northstar Island and continues 6 miles to within 2 miles of mainland Brownlow Point, is the largest barrier island between the Return Islands and the point. The western part of the island is mostly sand and gravel; the eastern part has tundra bluffs up to 20 feet in height and numerous small ponds, but fresh water is not available in any substantial quantity.

Passage has been made between Flaxman Island and Brownlow Point by staying close to the east end of the island until well into the lagoon; the channel has depths of 8 feet which shoal to 4 feet in the lagoon. The shoals that stretch from Brownlow Point to the east side of the narrow channel usually are marked by breakers or ice.

The mainland between Savakvik Point and Brownlow Point has numerous other points, sandspits, and bluffs. The west branch of Canning River empties into the lagoon southwest of Brownlow Point; the river delta forms extensive shoals in the eastern part of the lagoon.

Brownlow Point, 20 miles east of Savakvik Point, is the most northerly feature of **Canning River** delta; the tundra point has elevations up to 25 feet. A sand and gravel bar, partly bare at high water, extends from Brownlow Point southeastward past Canning River east branch to within 2 miles of Kangigivik Point.

From the Brownlow Point to Canning River east branch, the lagoon between the delta and the barrier bar is about 0.5 mile wide and has depths of 2 to 3 feet. The discharge from the river discolors the sea water for many miles. Southeastward of the river's east branch is a lagoon that provides excellent small-craft anchorage in depths of 8 to 10 feet; the best approach from seaward is around the southeast end of the barrier bar at a distance of 0.3 mile. A covered ridge that extends halfway from Kangigivik Point to the bar protects the lagoon from northeasterly wind-driven ice.

Kangigivik Point, 16 miles southeast of Brownlow Point, projects 2 miles northeastward from the mainland and is the western limit of **Camden Bay.** About a mile north of the point are extensive shoals that are partly awash; between the shoals and the point is a channel with depths of 7 to 17 feet. The lee provided by the shoals might be helpful in some conditions.

Launch anchorage has been reported east of Kangigivik Point, but there are large boulders in the area and boulders are seen along the entire shore of the point; natives use this anchorage in preference to Simpson Cove, to the east-southeastward, to avoid the ice that moves back and forth across Camden Bay with the winds. A better small-craft anchorage is in the lagoon 2 miles south of the point; the lagoon affords ample protection from all winds in depths of 4 feet. Entrance to the lagoon can be made through the break in the barrier bar across the mouth by staying close to the south shore.

Katakturak River empties into the south side of Camden Bay on the west side of **Simpson Cove,** which is 6 miles east-southeast of Kangigivik Point. The cove has excellent holding ground and affords protection from ice and wind for vessels drawing up to 6 feet; approach should be made from northeast of **Collinson Point,** the westerly end of the long narrow sandspit that extends from the mainland on the east side of the entrance. The best water is about 0.3 mile from the point; once past the point, there are depths of 9 to 11 feet in the greater part of the cove. Vessels should anchor as close to the weather shore as their drafts will permit.

Anderson Point, 15 miles east of Kangigivik Point, is the eastern limit of Camden Bay. The point is low and flat but behind it is a bluff that ranges in height from 4 to 30 feet and is prominent from westward; from eastward the bluff blends with the hills and is hard to see. Westward of Anderson Point the bottom slopes to depths of 10 to 12 feet very close to shore; north of the point the slope is gradual to depths of 2 or 3 feet, then sharp to depths of 12 to 30 feet.

Low, narrow, gravelly **Arey Island** begins about 10 miles northeast of Anderson Point and extends 3 miles northeast, then 2.5 miles east-southeast. The water is deep close to the outer shore of the island except at the southwest end. Incoming ice hits the northernmost part of Arey Island before any other place in the vicinity. A vessel can navigate very close to this part of the island if a lead can be found through the ice.

Barter Island, close eastward of Arey Island and about 45 miles east of Brownlow Point, is roughly triangular in shape, each side being 3 to 4 miles in length. The island rises to an elevation of 58 feet, is the highest ground in this general area, and has bluffs along its seaward side. **Kaktovik** (1960 population 120; P.O.) is the Barter Island village. Small amounts of food and other supplies are stocked for sale to the natives and are available to outsiders only in emergencies. There is an **Aero Radiobeacon (70°08′ N., 143°38′ W.)** on the island.

Off the northeastern end of Barter Island is **Bernard Spit,** a sand barrier that extends nearly 4 miles in an east-southeastward direction. Between the over-lapping ends of Barter Island and Bernard Spit is **Bernard Harbor,** which has depths of 5 to 7 feet over good holding bottom but can only be entered by drafts of 4 feet or less. The northern part of the harbor is out of the way of drifting bergs; ice does not get to this part of the harbor during westerly winds. Vessels entering Bernard Harbor from westward should favor the Barter Island shore; this passage may become blocked soon after the ice starts in.

Protection from ice and wind is available just east of the sandspit at the northwest end of Barter Island. The anchorage is not recommended for vessels drawing more than 5 feet.

Ice records of the Weather Bureau for Barter Island are meager but indicate a similarity to conditions at Barrow. Observations of Coast and Geodetic Survey field parties from 1948 through 1953 show that the ice usually breaks off from shore in late July or early August. After the breakup, ice is present in varying amounts and moves

on and off the shore with the winds until mid-September or early October when it freezes up for the winter.

Manning Point is a barrier spit that projects northward from the mainland to within 0.2 mile of the northeastern end of Barter Island. **Kaktoavik Lagoon,** between the spit and the island, and **Jago Lagoon,** on the east side of the spit, have depths of 9 to 12 feet but, like Bernard Harbor, cannot be entered by drafts greater than 4 feet.

Martin Point (70°07′ N., 143°16′ W.), low and irregular, is on the east side of the entrance to **Jago River** and 53 miles east of Brownlow Point. The west end of a barrier island is 2 miles northwest of Martin Point.

From Martin Point east-southeastward to Griffin Point, a distance of about 9 miles, the low, narrow barrier islands are less than 5 feet high and are separated from the mainland by shallow lagoons. Considerable driftwood has been deposited on the higher parts of the islands. The mainland shores of the lagoons have tundra bluffs with elevations up to 20 feet. There is deep water along the seaward sides of the barrier islands, and small boats can navigate within a few yards of the beach except near the inlets.

Griffin Point is a low sandspit that projects out from the mainland. A mile west-northwest of the point is a narrow barrier passage through which a depth of about 5 feet can be taken into **Oruktalik Lagoon.**

The barrier islands off Griffin Point continue southeastward for 3 miles; thence to Humphrey Bay are 25- to 30-foot bluffs fronted by narrow, steep sand beach except for the last 1.5 miles. Small boats can navigate very close to the beach between Griffin Point and Humphrey Bay.

Humphrey Bay, 17 miles southeast of Martin Point, is about 1.5 miles across. Bars extend out from both sides of the entrance. Depths are about 7 feet in the entrance and 10 to 12 feet in the bay proper. The entrance should be approached from the west, but care must be taken to stay off the sandbar that makes out from the northwest side. The bay has good holding bottom and good protection from ice and winds.

Tundra-covered **Humphrey Point,** on the southeast side of Humphrey Bay, has a low bluff and a narrow sand beach. Southeastward of Siku Point are low barrier islands that cover in many places at high water. The seaward sides of the islands are irregular, and small boats must stay well offshore.

Angnun Lagoon, behind the barrier reef between Humphrey Point and **Angnun Point,** 4 miles to the southeastward, has depths of 10 to 11 feet. There is a 10-foot bluff at Angnun Point. The lagoon entrance a mile northwest of Angnun Point is 75 to 100 yards wide and has a controlling depth of 8 feet.

Nuvagapak Lagoon, with depths of 9 to 12 feet, extends about 8 miles southeastward behind the barrier reef from Angnun Point to the delta of **Atchelik River. Nuvagapak Point,** high tundra, is a mile back of the reef and 3.5 miles southeast of Angnun Point. The principal entrance to the lagoon is a narrow channel with a controlling depth of about 5 feet 2 miles southeast of Angnun Point.

Egaksrak Lagoon, between Atchelik River and Siku Point, has not been surveyed but the entrances are known to be very shallow.

Siku Point (69°49′ N., 141°55′ W.), 16 miles southeast of Humphrey Point, is the northwest end of **Icy Reef,** a barrier that extends 13 miles southeastward to Demarcation Bay without a break. Icy Reef has elevations of 1 to 10 feet and is more prominent than the barrier islands to the northwest; the reef is a combination of several ridges built by wave action and has considerable driftwood along its entire length.

Broken ice can be expected along the seaward side of Icy Reef during most of the open season. Small boats usually can push through the ice by staying close to the beach or by taking advantage of the loosely packed ice farther offshore. There are depths of 15 feet within 100 yards of the beach and 30 feet within 0.3 mile.

The northwestern part of the mainland behind Icy Reef is low and relatively flat. Halfway along the mainland shore is a large ice field, about 3 miles long, which the Eskimos say never melts; observations from Icy Reef indicated that the ice field was fairly uniform and that it stood a few feet above the surface of the lagoon.

The southeastern half of the mainland shore behind Icy Reef has bluffs with elevations of as much as 25 feet. Four miles northwest of Demarcation Bay is bluff **Pingokraluk Point;** about 0.3 mile southeast of the point is a 50-foot-high tundra mound that is very prominent.

Demarcation Bay, 30 miles southeast of Humphrey Point, is about 5 miles in width by 3 miles in inland extent. **Demarcation Point,** on the east side of the entrance, is low tundra that rises gradually to a 30-foot bluff.

A depth of about 13 feet can be carried into Demarcation Bay 0.5 mile west of Demarcation Point; the bay has depths of 13 to 16 feet, sticky bottom, and good protection from all weather. Along the shores of the bay are bluffs with elevations up to 25 feet.

From Demarcation Point, Alaska, to **Clarence Lagoon,** 10 miles to the east-southeastward in Canada, the narrow, steep sand beach is backed by irregular bluffs. Small boats can navigate within a few yards of the beach, and there are depths of 30 feet 0.3 mile off.

Alaska-Canada Boundary Monument No. 1 (69°39′ N., 141°00′ W.) is 6.5 miles east-southeast of Demarcation Point; the 4-foot obelisk is 100 feet inland from the top of the bluff and is fairly conspicuous.

There is an **Aero Radiobeacon (69°35′ N., 140°11′ W.)** about 17 miles east by south of the boundary monument.

Herschel Island, Canada, about 40 miles east of the boundary, rises to an elevation of 550 feet. The island has an extent of about 10 miles from east to west and 7 miles from north to south. Thetis Bay, on the southeast side of the island, affords fairly good anchorage, sheltered from northerly and westerly winds, for vessels drawing up to 18 feet.

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 Science Center, Rockville, Md., 20852, or its distribution centers at San Francisco and New York, and by C&GS sales agencies which are listed semiannually in the Notice to Mariners.

West Coast Distribution Center.—San Francisco Regional Office, U.S. Coast and Geodetic Survey, 555 Battery Street, San Francisco, Calif.

Seattle Regional Office.—1801 Fairview Avenue East, Seattle, Wash., 98102.

Alaska Field Office.—306 Loussac-Sogn Building, Fifth and D Streets, Anchorage, Alaska, 99501.

United States Coast Pilots:

1. Atlantic Coast, Eastport to Cape Cod, 1960.
2. Atlantic Coast, Cape Cod to Sandy Hook, 1960.
3. Atlantic Coast, Sandy Hook to Cape Henry, 1961.
4. Atlantic Coast, Cape Henry to Key West, 1964.
5. Atlantic 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. Pacific and Arctic Coasts, Alaska—Cape Spencer to Beaufort Sea, 1964.

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

A Coast Pilot for which a supplement has been issued should not be used except with reference to the latest issue of its supplement. Supplements may be obtained from the headquarters office or distribution centers of the U.S. Coast and Geodetic Survey.

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.

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

Washington:

Anacortes: †Marine Supply & Hardware; †Transmission Supply, 902 Commercial Street.
Bellingham: †Griggs Stationery & Printing Co., 120 East Holly Street.
Bremerton: Bremerton Marine Supply, Inc., 1234 Charleston Beach.
Coulee Dam: Coulee Dam Nature & History Association.
Edmonds: Max Koner, % Surf & Sand Marina, 220 Railroad Avenue.
Everett: Black & King, 2944 Colby Avenue; Robinson Marina, Post Office Box 904.
Friday Harbor: †Friday Harbor Drug Co.
Hoquiam: Industrial & Marine Supply Co., 701 Levee Street.
Kelso: Cowlitz Marina, 85 Catlin Street.
Neah Bay: Washburn's General Merchandise.
Oak Harbor: Chuck Dann's Sporting Goods, Inc., 1150 West Pioneer Way.
Olympia: Sea Mart Marina, 611 North Columbia Street.
Port Angeles: †Willson Hardware Co., 111 West First Street.
Seattle: Chartmaster Co., 8306 16th Street NW.; *†Max Kuner Co., 1324 Second Avenue; *†Metsker Maps, 1020 Third Avenue; *†Northwest Instrument Co., 5245 Shilshole Avenue NW.; †Sbrock the Compass Adjuster, 1117 Northeast Boat Street; *Shrock the Compass Adjuster, Fisherman's Dock.
Tacoma: *†Metsker Maps, 111 South 10th Street.
Wallula: Kelly's Marine Supply, The Wallula Junction.
Westport: Tisch's Charter Service, West Front Street.

British Columbia:

Prince Rupert: Prince Rupert Fishermen's Supply Co., Ltd.
Vancouver: *†Bovey Marine 1952, 1117 West Pender Street; *Frederick Goertz, Ltd., 1328 West Pender Street; *Kelvin Hughes Division S. Smith & Sons (Canada) Ltd., 1790 West Georgia Street; *Western Marine Supply Co., Ltd., 528 Powell Street.

Victoria: *Ship Chandlers (McQuades) Ltd., 1252 Wharf Street.

Alaska:

Anchorage: Miller-Dalton Co., 564 Ocean Dock Road.
Cordova: Karl's.
Craig: J. T. Brown's Store.
Homer: The Sporter Arms Co.
Juneau: †J. B. Burford Co., 113 Fourth Street; †Northern Commercial Co.
Ketchikan: *†Service Electric Co., Inc., 744 Water Street.
Kodiak: †Kodiak Suppliers.
Pelican: Pelican Cold Storage Co.
Petersburg: The Trading Union.
Port Protection: B. S. Trading Post.
Sand Point: Aleutian Cold Storage Co.
Seldovia: H. S. Young Mercantile Co.
Seward: Durant's Hardware, Box 737.
Sitka: †Sitka Arts & Crafts.
Tenakee Springs: Snyder Mercantile Co.
Valdez: Valdez Drug Co., Inc.
Wrangell: Campbell & Hay, Inc.
Yakutat: Mallott's General Store.

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 agents.

Mississippi River (Cairo, Ill., to Gulf of Mexico): Published and 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 the 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 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, Atlantic and Mediterranean Area (H.O. Pub. No. 118A); Radio Weather Aids, Pacific and Indian Oceans Area (H.O. Pub. No. 118B); 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 Office: Elmendorf Air Force Base, Anchorage, Alaska. Coverage: coastal and tributary waters of Alaska.

COAST GUARD.—COMMANDER, 17th Coast Guard District, Community Building, Post Office Box 2631, Juneau, Alaska. Coverage: coastal and tributary waters of Alaska.

CUSTOMS DISTRICT.—The first port listed is the headquarters port. An (*) asterisk precedes the names of ports authorized to issue marine documents.

Alaska District: The limits are the State of Alaska.

Ports of entry: *Juneau, Anchorage, *Ketchikan, Kodiak, Pelican, Petersburg, Sand Point, *Sitka, Skagway, *Wrangell.

IMMIGRATION and NATURALIZATION.—Offices of this service are in the following places in Alaska:

Anchorage: Room 142, U.S. Post Office & Customhouse Building.

Juneau: Fifth Street School Building.

Ketchikan: Room 208, Federal Building, Mission and Stedman Streets.

PUBLIC HEALTH SERVICE.—Quarantine stations in Alaska where supervision of quarantine and medical examinations of aliens are performed:

Anchorage; additional places where inspections and examinations are made: Guard Island, Juneau, Ketchikan, Kodiak, St. Paul Island, Seward, Shemya, Sitka, Ward Cove, Whittier, and Wrangell.

Outpatient offices:

Cordova.
Juneau: Box 2627.
Ketchikan: Koel Building, 325 Dock Street.
Nome: Maynard MacDougall Hospital.
Petersburg: Box 1054.
Seward: Seward General Hospital.

FEDERAL COMMUNICATIONS COMMISSION.—District field office:

Anchorage: U.S. Post Office and Courthouse.

WEATHER BUREAU.—Barometers may be compared with standards at the following offices:

Anchorage: Anchorage International Airport.

Juneau: Juneau Airport.

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 (local standard) and indicated frequencies preceded by an initial call on 2182 kc. Urgent broadcasts are made on 2182 kc. upon receipt.

NMJ, Ketchikan, 2670 kc., 6:30 a.m., 10 a.m., and 10 p.m.

NOJ, Kodiak, 2670 kc., 9 a.m. and 9 p.m.

Radiotelegraph broadcasts by Coast Guard.—Scheduled marine information broadcasts of notices to mariners, hydrographic information, storm warnings, advisories, and other important information are broadcast by radiotelegraph at the scheduled times (local standard) 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. Urgent broadcasts are preceded by the Urgent Signal (XXX).

NMJ, Ketchikan, 466 kc., 9:30 a.m. and 9:30 p.m.

Radiotelephone broadcasts of weather information.—Regular broadcasts of weather forecasts, storm warnings, and other information are made on local standard time in plain language by the following radiotelephone stations:

AKO, Anchorage, 2312 kc., 8 a.m. and 7 p.m. daily.

AKO 66, Cold Bay, 2312 kc., 11 a.m., 2 p.m., and 5 p.m. daily (seasonal).

AKO 44, Cordova, 2300 kc., odd hours 8 a.m. to 5 p.m. weekdays (seasonal).

AKM, Juneau, 2784 kc., 6:30 and 8:30 a.m., 1, 6:30, and 8:30 p.m. daily.

AKL, Ketchikan, 2300 kc., 10:15 a.m., 4:15 and 10:15 p.m. daily.

AKO 77, King Salmon, 2312 kc., 8:30 a.m., 2:30 and 7 p.m. daily (seasonal).

AKO 99, Kodiak, 2784 kc., odd half-hour, 9 a.m. to 6 p.m. weekdays.

AKM 44, Sitka, 2312 kc., 11 a.m., 2 and 5 p.m. weekdays (seasonal).

AKP 33, Unalaska, 2312 kc., 9 a.m. weekdays (seasonal).

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 put on the air at least twice 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.

LEGAL HOLIDAYS.—The following holidays are observed in Alaska:

January 1, New Year's Day; February 12, Lincoln's Birthday; February 22, George Washington's Birthday; March 30, Seward's Day; May 30, Memorial Day; July 4, Independence Day; September (first Monday), Labor Day; October 18, Alaska Day; November 11, Veterans Day; November (fourth Thursday), Thanksgiving Day; December 25, Christmas Day.

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.

YAKUTAT, ALASKA (Federal Aviation Agency Airport), 59°31'N., 139°40'W.; Elevation (ground) 28 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	5:00 a.m. Local time	3:00 p.m. Local time	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		15	13	13	13	13	13			13	13	13	13	15	13	13	13
Jan.	33.0	19.9	26.5	49	-22	11.60	5.10	38.1	82	80	7.6	E			7.5	6	4	21	18	8	*	2
Feb.	34.9	21.1	28.0	49	-19	8.61	2.35	44.1	85	79	7.8	E			8.0	4	3	21	17	11	0	2
Mar.	38.0	23.5	30.8	55	-13	9.89	3.33	43.7	82	73	7.1	E			7.7	4	5	22	17	9	0	3
Apr.	44.4	28.6	36.5	66	3	7.98	2.69	16.7	79	72	6.9	E			8.0	4	5	21	17	5	0	2
May	51.2	35.3	43.3	76	22	7.82	3.50	0.5	79	74	7.2	ESE			8.3	3	5	23	18	*	0	3
June	56.8	42.2	49.5	81	30	4.96	2.50	0.0	81	75	7.0	ESE			8.5	2	5	23	15	0	0	4
July	58.6	46.8	52.7	84	36	8.63	5.36	0.0	84	79	6.3	ESE			8.6	2	5	24	17	0	*	3
Aug.	59.3	46.2	52.8	86	30	10.54	4.77	0.0	86	79	6.3	ESE			8.5	3	4	24	18	0	*	5
Sep.	55.0	41.8	48.4	77	25	16.32	6.38	T	88	79	6.6	E			8.6	2	4	24	20	0	*	4
Oct.	47.9	35.4	41.7	60	12	19.93	4.24	4.9	86	77	7.7	E			8.4	4	2	25	23	1	*	1
Nov.	39.6	27.8	33.7	59	-10	15.46	7.13	20.4	88	84	8.2	E			8.5	3	3	24	21	4	*	1
Dec.	33.7	21.8	27.8	52	-15	12.31	3.76	47.6	87	86	8.6	E			8.6	3	3	25	23	11	*	2
Year	46.0	32.5	39.3	86	-22	134.15	7.13	216.0	84	78	7.3	E			8.3	40	48	277	224	50	1	31

CORDOVA, ALASKA (Mile 13 Airport), 60°30'N., 145°30'W.; Elevation (ground) 40 feet. WB-61

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. Local time	2:00 p.m. Local time	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)				18	18		18	18	16	16					16	16	16	16	18	16	18	16
Jan.	32.4	17.6	25.0	58	-27	7.05	2.66	24.9	82	81	3.8	E			7.2	7	4	20	17	7	0	2
Feb.	34.6	17.5	26.1	49	-33	5.27	3.42	23.8	82	78	4.2	E			7.2	6	4	18	15	7	0	1
Mar.	37.5	22.7	30.1	52	-24	5.92	3.56	22.6	82	74	4.3	E			7.1	7	5	19	16	6	0	1
Apr.	43.8	28.9	36.4	65	- 9	5.07	2.80	11.1	78	70	4.5	ESE			7.5	6	4	20	15	4	0	1
May	50.4	35.3	42.9	77	20	6.44	2.88	1.5	80	72	4.4	E			8.4	3	4	24	20	*	0	2
June	57.4	41.2	49.3	79	29	4.19	2.79	0.0	81	76	3.9	SW			8.4	2	5	23	16	0	*	1
July	60.1	46.4	53.3	84	34	6.44	6.60	0.0	86	79	3.3	E			8.7	2	4	25	19	0	*	1
Aug.	61.3	45.5	53.4	80	30	9.72	3.94	0.0	87	79	3.2	E			8.2	3	5	23	19	0	*	2
Sep.	55.7	40.2	48.0	71	20	15.47	7.92	T	88	78	4.3	E			8.2	3	4	23	20	0	*	1
Oct.	47.8	33.9	40.8	70	11	15.56	6.29	2.8	87	78	4.8	E			8.0	4	4	23	21	1	*	*
Nov.	38.2	23.9	31.1	55	-17	10.55	4.48	10.5	87	83	4.6	E			8.0	4	4	22	19	4	*	*
Dec.	34.1	19.1	26.6	47	-19	6.96	4.66	29.5	85	83	4.3	E			7.9	5	4	22	19	8	*	1
Year	46.1	31.0	38.6	84	-33	98.64	7.92	126.7	84	78	4.2	E			7.9	52	51	262	216	37	2	12

ANCHORAGE, ALASKA (International Airport), 61°10'N., 149°59'W.; Elevation (ground) 90 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. Local time	2:00 p.m. Local time	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.	20.4	5.5	13.0	50	-23	0.76	1.19	9.7	72	71	4.9	NNE		38	6.8	8	4	19	8	3	0	7
Feb.	26.9	10.3	18.6	43	-26	0.58	1.16	16.0	71	65	5.7	N		43	7.0	6	4	18	9	4	0	5
Mar.	33.8	15.7	24.8	47	-22	0.60	0.51	8.9	66	54	5.8	N		60	6.2	10	5	16	6	3	0	1
Apr.	44.2	26.6	35.4	61	6	0.40	0.59	6.2	65	54	6.0	N		58	6.9	6	7	17	6	2	0	1
May	55.0	36.4	45.7	72	27	0.51	0.55	0.0	61	48	7.5	S		53	7.6	4	6	21	5	0	0	*
June	62.8	44.5	53.7	77	33	0.89	1.71	0.0	65	54	6.9	S		53	7.5	3	9	18	7	0	*	*
July	65.4	49.1	57.3	81	39	1.55	2.06	0.0	72	61	6.3	S		42	7.9	3	6	22	14	0	1	*
Aug.	63.9	47.3	55.6	77	34	2.56	1.68	0.0	75	63	5.5	S		39	8.0	3	8	22	14	0	1	1
Sep.	56.3	39.6	48.0	73	20	2.71	1.92	T	78	62	5.1	NNE		40	7.9	4	5	21	15	0	*	2
Oct.	43.2	28.9	36.0	60	- 5	1.87	0.88	9.2	75	64	5.3	N		41	7.2	7	5	19	9	3	0	2
Nov.	28.0	15.5	22.3	48	-21	1.00	0.80	14.7	73	71	5.1	NNE		28	7.9	4	4	22	10	4	0	4
Dec.	20.4	7.1	13.8	43	-30	0.84	1.62	15.7	73	72	4.8	NNE		32	7.1	7	4	20	9	4	0	6
Year	43.4	27.2	35.3	81	-30	14.27	2.06	80.4	70	62	5.7	NNE		44	7.3	65	65	235	111	23	2	30

COLD BAY, ALASKA (Cold Bay Airport), 55°12'N., 162°43'W.; Elevation (ground) 94 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	7:00 a.m. Local time	1:00 p.m. Local time	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)				17	18		16	11	6	6	6	6			6	6	6	6	16	11	6	6
Jan.	33.5	24.7	29.1	49	- 5	2.52	2.49	7.6	86	84	15.8	SSE			8.4	1	6	24	17	3	0	4
Feb.	32.7	24.0	28.4	50	- 9	2.76	2.49	8.8	85	81	15.6	SSE			8.4	2	4	22	16	2	0	2
Mar.	34.4	24.9	29.7	54	- 7	1.89	1.34	9.5	84	76	15.8	NNW			7.8	3	7	21	17	3	0	2
Apr.	38.6	29.8	34.2	60	4	1.34	1.76	5.7	85	79	15.6	SSE			8.7	1	6	23	12	2	0	1
May	44.1	34.9	39.5	62	21	1.69	2.22	1.2	86	78	14.6	SSE			9.1	*	3	28	16	*	0	2
June	50.4	40.9	45.7	69	29	2.64	2.02	T	87	77	13.5	SSE			9.2	1	2	27	14	0	0	2
July	54.4	45.5	50.0	77	36	2.14	1.20	0.0	91	82	13.8	SSE			9.5	*	2	29	16	0	0	6
Aug.	56.3	47.9	52.1	78	33	3.97	2.17	0.0	92	84	14.6	SSE			9.5	0	2	29	19	0	0	3
Sep.	51.5	43.4	47.5	70	30	3.57	1.86	T	88	79	14.9	SSE			9.2	0	3	27	18	0	0	1
Oct.	44.6	36.5	40.5	69	20	4.38	2.52	1.0	85	77	15.5	WSW			8.5	2	4	25	21	*	0	1
Nov.	38.7	30.6	34.7	54	8	3.82	2.75	5.6	84	80	16.4	SSE			8.6	1	6	23	20	2	0	*
Dec.	34.1	25.4	29.8	47	- 9	2.48	1.76	7.8	83	82	15.4	NNW			8.6	1	5	25	18	2	0	3
Year	42.6	34.0	38.4	78	- 9	33.20	2.75	47.2	86	80	15.1	SSE			8.8	12	50	303	206	15	0	27

SHEMYA, ALASKA (Shemya Airport), 52°43'N., 174°6'E.; Elevation (ground) 122 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	7:00 a.m. Local time	1:00 p.m. Local time	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		12	10	6	6	11	11	15						12	13		
Jan.				45	18		1.32	12.7	84	93	17.9	ENE	86WSW						21	3		
Feb.				42	18		2.12	13.2	82	80	17.8	NNE	70SW						18	5		
Mar.				42	17		2.40	13.5	84	82	17.4	ESE	69SSE						18	4		
Apr.				46	21		1.55	3.7	83	82	15.3	NW	63SSE						14	1		
May				51	28		1.60	0.7	88	85	14.3	NW	52NNE						15	*		
June				57	30		1.76	T	93	89	11.6	NW	48SSE						14	0		
July				63	39		1.71	0.0	96	91	11.4	WSW	43WSW						15	0		
Aug.				60	39		1.29	0.0	95	90	11.5	WSW	48S						16	0		
Sep.				58	38		1.65	T	90	85	13.4	WSW	62SW						15	0		
Oct.				54	26		1.14	0.5	87	84	17.6	WSW	69WNW						22	*		
Nov.				48	22		1.59	5.9	86	84	18.3	WNW	77W						21	3		
Dec.				46	18		1.03	12.3	83	82	17.1	WSW	121SW						19	4		
Year				63	17		2.40	62.5	88	85	15.3	WSW	121SW						207	21		

ST. PAUL ISLAND, ALASKA (Airport), 57°09'N., 170°13'W.; Elevation (ground) 22 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	7:00 a.m. Local time	1:00 p.m. Local time	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)				44	44		39	38	13	13					32	36	36	36	43	36	28	28
Jan.	29.9	22.9	26.4	48	-26	1.82	1.16	12.8	87	86					8.2	3	6	22	17	4	0	1
Feb.	27.7	19.9	23.8	44	-13	1.13	1.51	8.8	85	84					8.0	2	7	19	14	4	0	2
Mar.	28.8	20.1	24.5	44	-17	1.17	1.04	8.2	86	83					7.7	4	8	19	14	3	0	2
Apr.	33.8	26.3	30.1	44	- 2	1.02	0.72	4.7	88	84					8.1	3	6	21	13	1	0	3
May	39.1	31.2	35.2	56	14	1.18	1.27	1.9	92	86					8.7	2	4	25	13	1	0	5
June	45.6	37.3	41.5	62	26	1.31	1.48	0.1	94	86					8.9	1	4	25	12	*	*	7
July	49.3	42.4	45.9	62	28	2.43	1.92	0.0	96	91					9.1	1	3	27	15	0	0	10
Aug.	51.0	44.9	48.0	64	32	2.99	1.91	0.0	96	91					9.1	1	4	26	19	0	0	8
Sep.	48.6	42.0	45.3	59	27	3.49	1.58	0.1	92	86					8.6	1	6	23	20	*	0	3
Oct.	42.3	35.9	39.1	54	13	3.12	1.83	2.2	87	82					8.4	1	8	22	22	*	0	*
Nov.	37.0	30.6	33.8	50	9	2.59	1.76	5.3	85	82					8.3	1	7	22	21	2	*	*
Dec.	32.7	25.8	29.3	52	- 5	1.09	1.15	9.6	83	81					8.4	2	6	23	19	4	0	*
Year	38.6	31.6	35.2	64	-26	24.24	1.93	53.7	89	85					8.5	22	69	274	200	18	*	42